# The American Journal of Surgery

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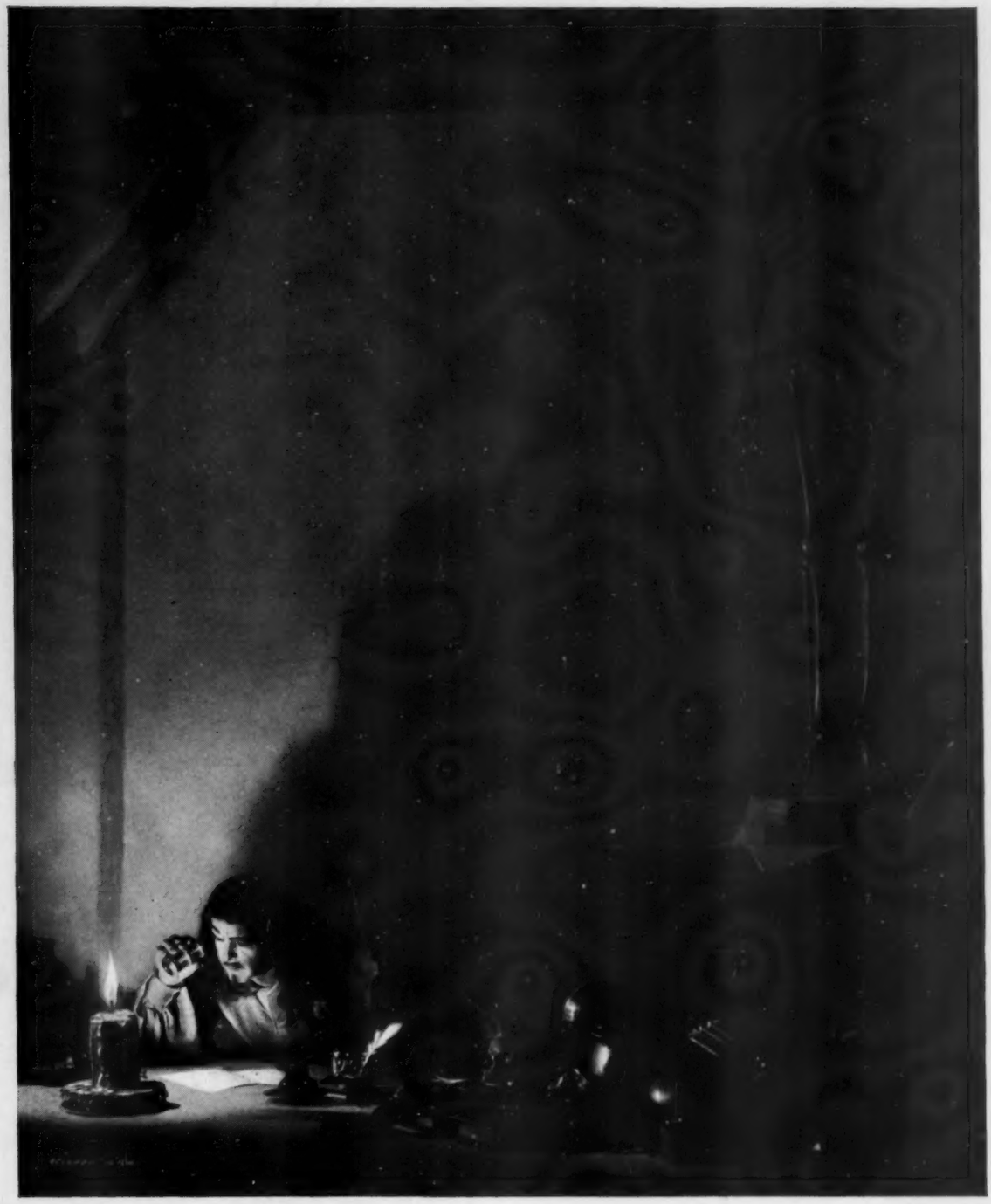


*Marcello Malpighi*

(1628-1694)

# SUTUREGRAM

NUMBER TWELVE IN A SERIES

## Suturing of Traumatic Wounds

Traumatic wounds should not be sutured primarily unless:

(1) Interval preceding treatment is less than ten hours

(2) All foreign bodies are removed

(3) All crushed tissue is removed

(4) Bacterial contamination is minimized

Last three factors accomplished by debridement

# SUTUREGRAM

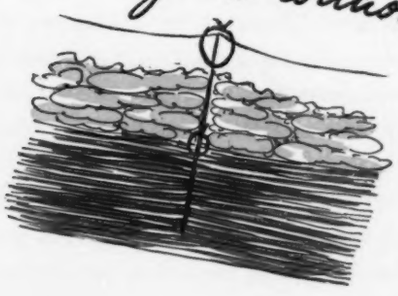
**NUMBER TWELVE (CONTINUED)**

If conditions are not obtained, then delayed primary suturing should be done

✓ Step #1 Debridement

✓ Step #2 Wound packed open with gauze

✓ Step #3 Five to eight days later gauze removed, remnants of slough excised and wound sutured in layers without drainage



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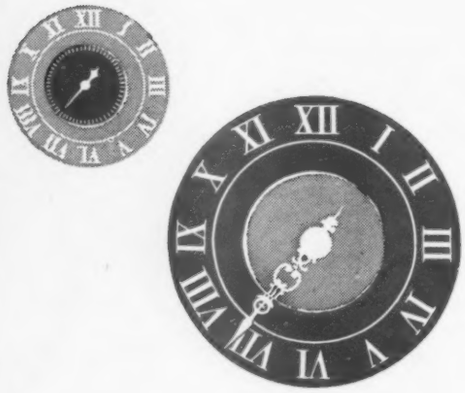

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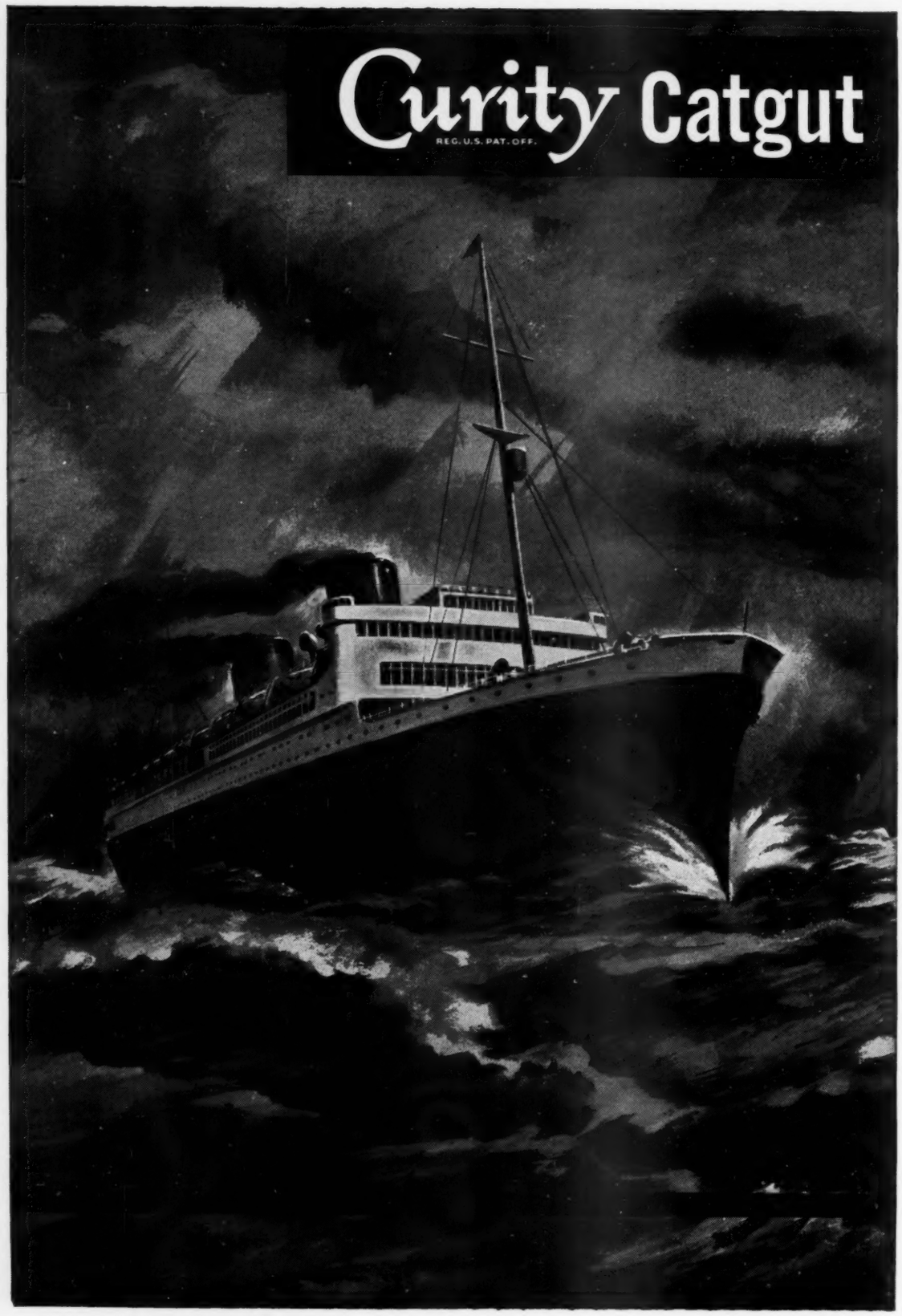
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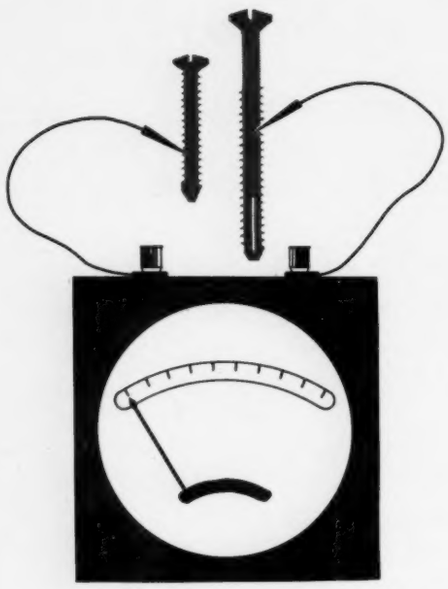

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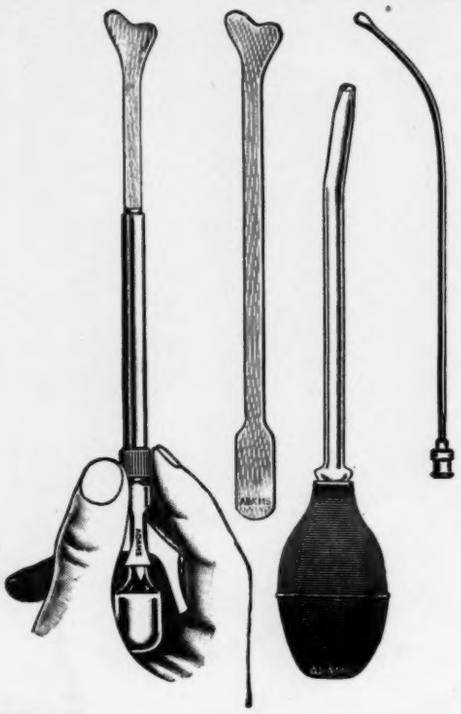

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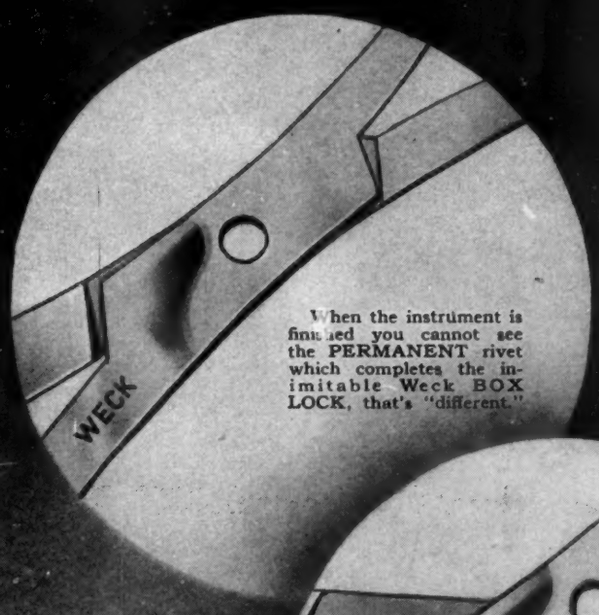


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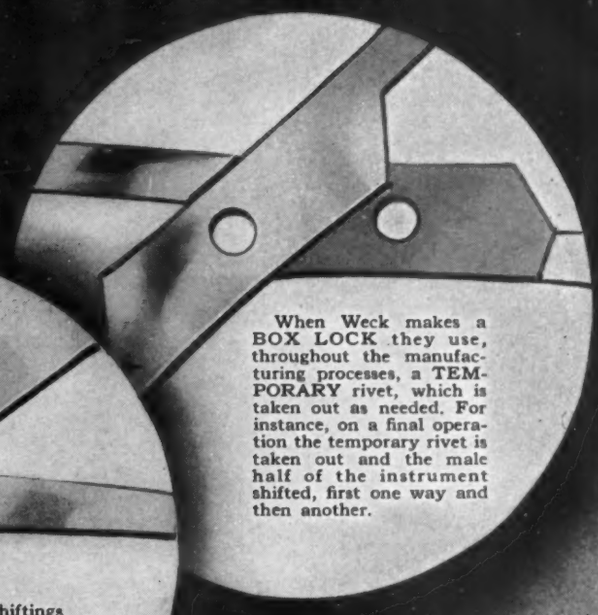

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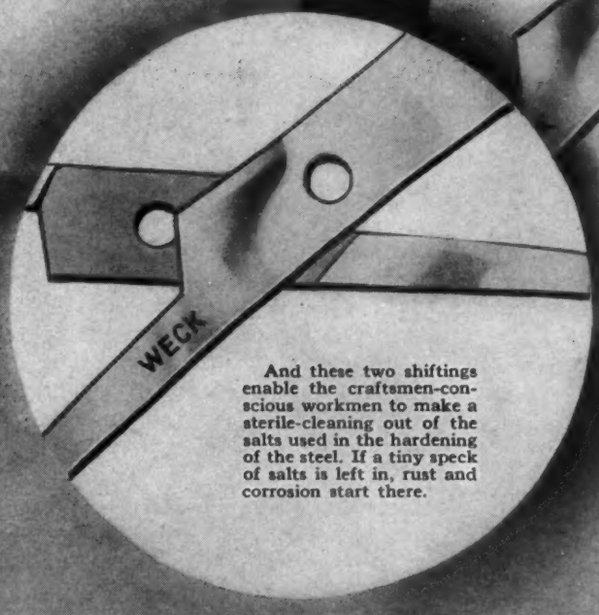


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**Nausea and Vomiting**
**Eclampsia**
**Amnesia and Analgesia[6]**

**SURGICAL**
**Preoperative Sedation**
**Basal Anesthesia**
**Postoperative Sedation**

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**Sedation for.**
Special examinations
Blood transfusions
Administration of parenteral fluids
Reactions to immunization procedures
Minor surgery

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*Nembutal alone or*
*[1]Glucophylline® and Nembutal,*
*[2]Nembutal and Belladonna,*
*[3]Ephedrine and Nembutal,*
*[4]Nembudeine®,*
*[5]Nembutal and Aspirin,*
*[6]with scopolamine or other drugs.*

## satisfying a wide variety of needs

That, too, is the function of short-acting Nembutal—satisfying a wide variety of needs. With over 470 papers already published on the clinical uses of short-acting Nembutal, more than 44 conditions have been reported in which it has been effectively employed. As a result, more and more physicians are seeing new opportunities for its use. They have learned that adjusted doses of Nembutal make possible any degree of cerebral depression from mild sedation to deep hypnosis. Short-acting Nembutal requires only about *one-half* the dosage of many other barbiturates. With small dosage, there is less drug to be inactivated, less possibility of "hangover," shorter duration of effect, wide margin of safety. Eleven Nembutal products—all in convenient small-dosage forms—are available at your pharmacy. Write for the comprehensive new booklet, "44 Clinical Uses for Nembutal." ABBOTT LABORATORIES, North Chicago, Ill.

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## Better visualization and smoother manipulation permit improved techniques

This small, compact procto-sigmoidoscope incorporates improved features in rectal snares, grasping forceps, telescopic attachments and variable size speculum.

Included with the instrument are two proctoscope tubes (10" working length) of 1" and ¾" diameters. Each tube is equipped with an obturator and a specially designed light carrier which focuses a brilliant beam of light on the distal end without interfering with the visual field.

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***Full information sent on request***

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## Simplifies Management of Post-tonsillectomy Hemorrhage

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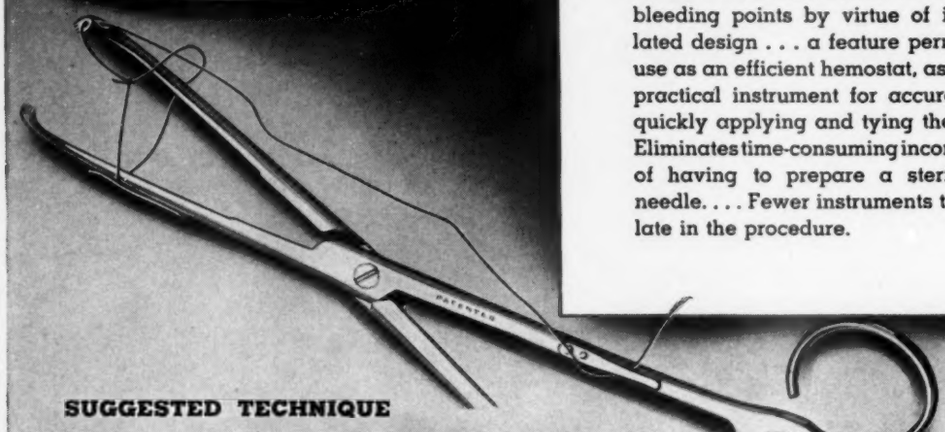
serves a dual function in the ligation of bleeding points by virtue of its cannulated design . . . a feature permitting its use as an efficient hemostat, as well as a practical instrument for accurately and quickly applying and tying the ligature. Eliminates time-consuming inconvenience of having to prepare a sterile suture needle. . . . Fewer instruments to manipulate in the procedure.



A Kny-Scheerer quality instrument, precision-made for discriminating surgeons.

**SUGGESTED TECHNIQUE**

Tie an ordinary slip-noose with ligature, pulling knot very tightly. Cut short end about ⅜" from knot.

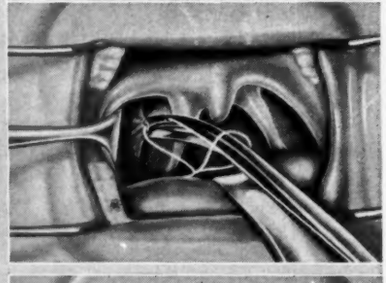
Thread the long end through the eye on the external surface near tip of one end of the jaws.

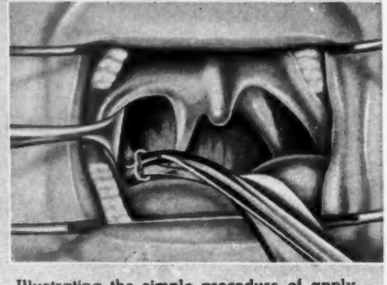
The noose of the ligature, which should be about 1" in diameter, is thrown over both jaws and held out of grasp by the latter by a steel spring clip on the jaw opposite the one with eye.

Grasp the bleeding point of tissue in the usual manner and with a slow, even pull, parallel to the instrument, the loop is drawn gradually free from the clasp and around the bleeding point.

When tightly tied, relax the pull, open the hemostat and withdraw two or three inches and cut the ligature about ⅜" from the tissue.

If the ligature is cut long enough at the beginning, several vessels may be ligated without re-threading by simply tying a new loop after each tying operation, thus saving time and material.





Illustrating the simple procedure of applying and tying ligature by means of the cannulated hemostat in cases where pressure tampon fails to control hemorrhage.

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With physicians and surgeons suggesting various sizes, for their own convenience, of this uniquely effective dressing as Cover, Pack, and Drain for wounds and burns, Baybank is pleased to announce a further development—the *Duplex Package!* This new package contains *two* 3" x 18" '*Vaseline*' Sterile Petrolatum Gauze Dressings, each a fine-meshed, sterile, absorbent gauze strip uniformly saturated with sterile white petroleum jelly U.S.P., accordion-folded, and heat-sealed in its own compartment of a compact "Siamese twin" aluminum-foil envelope. In the Duplex Package, Dressings are identical in every respect, except length, with Dressings in the Individual Package.

Dependably sterile... easily stored... Baybank Dressings are always ready for either routine or emergency use in hospital, home, factory, doctor's office, ambulance, or at site of accident. Both packages available through Surgical and Hospital Supply Dealers.

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## Sterile Petrolatum Gauze Dressing

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**(5) Undiminished antibacterial activity against *Mycobacterium tuberculosis***

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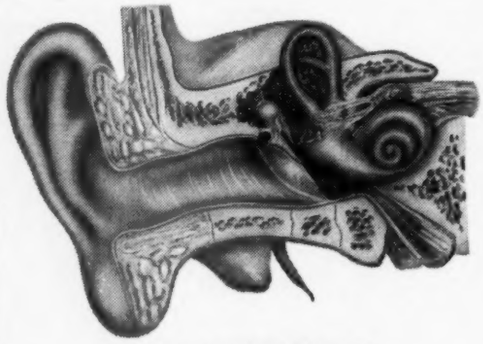
It can be used interchangeably for intramuscular therapy with Streptomycin Calcium Chloride Complex Merck or other forms of streptomycin.

*Descriptive literature is yours for the asking.*



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## DIHYDROSTREPTOMYCIN MERCK

**(supplied as the sulfate)**

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**Chronic osteomyelitis** of *12 years' duration* after compound fractures of leg. 14 surgical procedures failed to close the cavity. Pain and foul-smelling discharge caused patient to request amputation.

**Treatment with Chloresium** brought progressive closure of the cavity. Purulent drainage and odor stopped. Pinch grafts of granulation tissue at base were successful and cavity closed completely.

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## where other methods of treatment failed

● The case shown above is one of hundreds which resisted other methods of treatment—until Chloresium therapeutic chlorophyll preparations were used. The published record* shows that the great majority of them not only *responded rapidly* to Chloresium's chlorophyll therapy, but *healed completely* in a relatively short time.

### *Faster healing of acute cases*

Results with Chloresium in acute wounds and burns have been equally dramatic. Faster healing, less infection, less scar tissue formation have been obtained. In addition, Chloresium provides quick deodorization of foul-smelling conditions.

This new approach to prompt, effective healing is due to Chloresium's proved ability to stimulate normal cell growth. Now, *for the first time*, you can give *positive help* to tissue in repairing itself. Try it on your most resistant case —it is completely nontoxic, bland and soothing.

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**Solution (Plain); Ointment; Nasal and Aerosol Solutions**
***Ethically promoted—at leading drugstores***


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|---|---|---|
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| Rafsky, Henry A. and Kreiger, Charles I. | Treatment of Intestinal Diseases with sols. of w. s. Chlorophyll | Rev. Gastroent Vol. 15:549 (1948) |


**NEW**—Chloresium Dental Ointment and Tooth Paste now make chlorophyll therapy available for the treatment of Vincent's infections, gingivitis and other periodontal diseases.

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I want to try Chloresium on my most resistant case. Please send me, without obligation, clinical samples and complete literature.

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# Outside the Ivory Tower

ANESTHESIOLOGY is fast coming into its own. As a specialty it has grown to mature stature. We are informed that 3,000 hospitals in this country still are without trained anesthesiologists, but schools of anesthesiology, headed by approved, competent personnel are being created every week. But it will take a long time before the supply will meet the demand. Meanwhile, authoritative, well written works on all or any part of this specialty are welcome. Such a work is now available. "Pediatric Anesthesia," by M. Digby Leich, M.D. and M. Kathleen Belton, M.D. is published by The Macmillan Company, New York, and costs $5.50 per copy.

The field of pediatric anesthesia has grown recently and includes most of the various anesthetic agents and technics employed in the adult. This growth has kept pace with advances made in pediatric surgery. This work discusses many of the methods which the authors have used satisfactorily over a period of years. We read, "The margin of safety in infants and children with the various technics is considerably less than in adults, but it is our [the authors] belief that the more complicated technics can be safely used if the fundamentals of good anesthesia are observed."

After an introduction the chapter headings are: Preoperative Preparation, Respiration and Circulation, Stages and Planes of Anesthesia, Inhalation Anesthesia, Intubation, Intravenous Anesthesia, Rectal Anesthesia, Anesthesia with Local Agents, Choice of Anesthetic Agent and Technic, Complications During Anesthesia, Postoperative Care: Prophylaxis and Therapy with Oxygen, and Fluid Therapy. Two pages are devoted to References and there is an ample Index. It is an excellent book for all interested in anesthesiology, especially interns, residents and nurse technicians.

Both authors are recognized as leaders in their field, and we believe theirs are the last words on this subject to date.

ONE hundred fifty-one life insurance companies are contributing $600,000 a year to the Life Insurance Medical Research Fund. The Fund is financing more than fifty research organizations for the basic study of the few known and the many unknown causes of heart disease.

Dr. Francis Dieuaide, eminent heart specialist and scientific director of the Fund, says: "Despite its being the greatest single killer of all diseases, we know almost nothing about heart disease. Chief reason is that there has been almost no continued organized research on cardiac science. While infectious disease—in fighting which there has been great success—has had $6.15 in research funds for every death from the diseases, heart study has had but 21 cents per death up to the establishment of this life insurance fund. Our appropriation represents about 90 cents per death—still small, but a step toward greater knowledge.

"We start from scratch—so much so that we have to find out what to find out. The Fund's researchers are exploring into the deeps of physiology, biology and biochemistry for leads that will help us to understand causes and thus, eventually, discover a cure. And we look for no results in a hurry. But though we have no startling discoveries to offer, it seems to me important and interesting to the public in general that the life insurance business itself is engaged in the biggest private enterprise to enlarge the knowledge with which we can really battle heart disease—which slays more than 600,000 people every year."

THE American Society of Medical Technologists will hold its seventeenth annual convention June 20, 21, 22, and 23, 1949, at the Hotel Roanoke, in Roanoke, Va. Further information may be obtained from Miss Ida L. Reilly, M.T. (ASCP), Roanoke Hospital Association, Roanoke, Va., who is the Convention Chairman.

(*continued on page* 34)

# For surface infections . . .

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SOLUBLE DRESSING
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CONTAINS 0.2% NITROFURAZONE (5-NITRO-2-FURALDEHYDE SEMICARBAZONE) IN A WATER SOLUBLE BASE.
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DESCRIPTION OF PRODUCT AND USES AVAILABLE TO PHYSICIANS ON REQUEST.
AN ANTIBACTERIAL PREPARATION FOR TOPICAL APPLICATION
EATON LABORATORIES Inc.
NORWICH, NEW YORK
ONE POUND, AVOIR.

***Although burned tissues supply an excellent medium for bacterial growth,*** infection may be minimized by the prompt, topical application of an efficient antibacterial agent. For this purpose, fine-mesh gauze strips impregnated with Furacin Soluble Dressing may be used. The effectiveness of Furacin in combatting mixed infections of burns without delay of healing has been well demonstrated.* Furacin N.N.R., brand of nitrofurazone, is available as Furacin Soluble Dressing and as Furacin Solution, both containing 0.2 per cent Furacin.® These preparations are indicated for topical application *in the prophylaxis and treatment of infections of* wounds, second and third degree burns, cutaneous ulcers, pyodermas and skin grafts. *Literature on request.*

**EATON LABORATORIES, INC., NORWICH, N.Y.**

*Snyder, M. L., Kiehn, C. L. and Christopherson, J. W.: Mil. Surgeon, *97*: 380, 1945. • Shipley, E. R. and Dodd, M. C.: Surg., Gynec. & Obst., *83*: 366, 1947 • Mays, J. L.: J. Med. Assoc. Georgia, *36*: 263, 1947. • Curtis, L.: Surg. Clin. N. America, 1466 (Dec.) 1947.

# *In the Hustle and Bustle*

## A MEAL IS LOST

THE few minutes saved by skipping breakfast, or eating a skimpy breakfast, may be more costly than generally realized. The student loses in power to concentrate, the worker in acuity, the housewife in stamina. Yet a surprisingly large segment of our population is guilty of this sin of omission.

In the aim to provide one-fourth to one-third of the daily caloric and nutrient needs in the morning meal, breakfast can be planned profitably around a widely endorsed basic breakfast pattern. Consisting of fruit or fruit juice, breakfast cereal, milk, bread and butter, this meal provides well balanced nutrient composition, economy, and almost endless variety. Its nutrient contribution, and that of the cereal serving, consisting of cereal, milk, and sugar, are outlined in the tables.

*The presence of this seal indicates that all nutritional statements in this advertisement have been found acceptable by the Council on Foods and Nutrition of the American Medical Association.*

**CEREAL INSTITUTE, INC.**

**A RESEARCH AND EDUCATIONAL ENDEAVOR DEVOTED TO THE BETTERMENT OF NATIONAL NUTRITION**

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| BASIC BREAKFAST | TOTALS supplied by Basic Breakfast | AMOUNTS supplied by cereal serving |
|---|---|---|
| Orange juice, 4 fl. oz.; | CALORIES..... 611 | 202 |
| Ready-to-eat or Hot Cereal, 1 oz.; | PROTEIN..... 20.7 Gm. | 7.1 Gm. |
| Whole Milk, 4 fl. oz.; | CALCIUM.....0.465 Gm. | 0.156 Gm. |
| Sugar, 1 teaspoon; | PHOSPHORUS.... 488 mg. | 206 mg. |
| Toast (enriched, white), 2 slices; | IRON..... 3 mg. | 1.6 mg. |
| Butter, 5 Gm. (about 1 teaspoon); | VITAMIN A..... 1074 I. U. | 193 I. U. |
| Whole Milk, 8 fl. oz. | THIAMINE..... 0.52 mg. | 0.17 mg. |
| | RIBOFLAVIN..... 0.87 mg. | 0.24 mg. |
| | NIACIN..... 2.3 mg. | 1.4 mg. |
| | ASCORBIC ACID.. 64.8 mg. | |

**Composite average of all breakfast cereals on dry weight basis.*

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## Has no equal in . . .
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## FINGER-TIP ADJUSTABILITY
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Surgeons and operating room personnel who have used the new Castle SAFELIGHTS agree that these are the first surgical spotlights to really combine explosion-proof safety with superior illumination and easy maneuverability.

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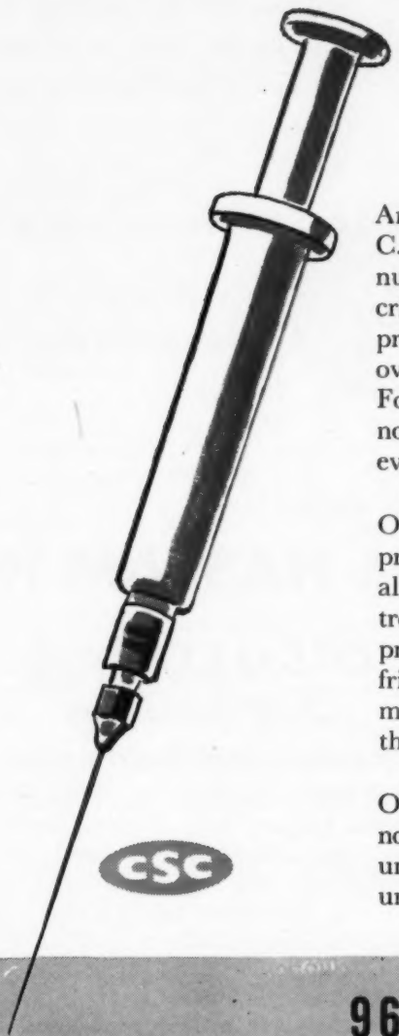


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Crystalline Procaine Penicillin G in Peanut Oil-C.S.C. contains 300,000 units of micronized procaine penicillin per cc., together with 2% aluminum monostearate for producing a thixotropic suspension. This outstanding penicillin preparation is free flowing and requires no refrigeration. It is indicated in the treatment of most infectious diseases amenable to penicillin therapy.

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**CRYSTALLINE PROCAINE PENICILLIN G**
**IN PEANUT OIL**
**WITH 2% ALUMINUM MONOSTEARATE**

*C.S.C. Pharmaceuticals*

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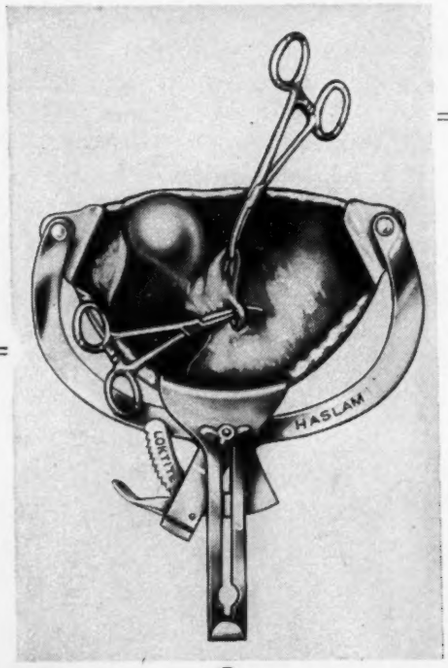


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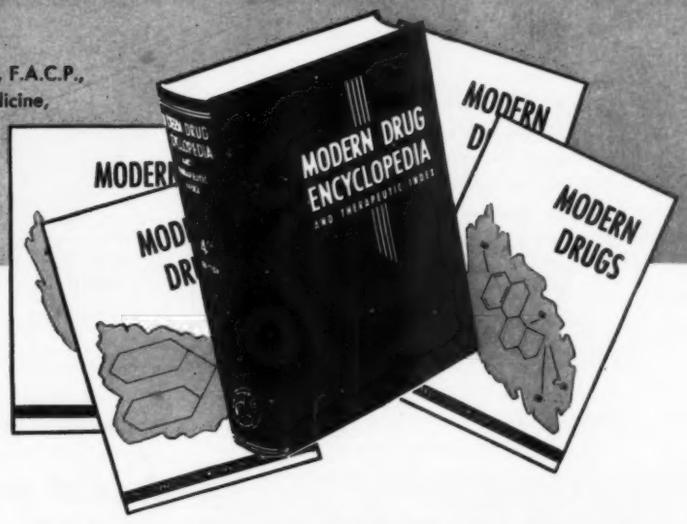


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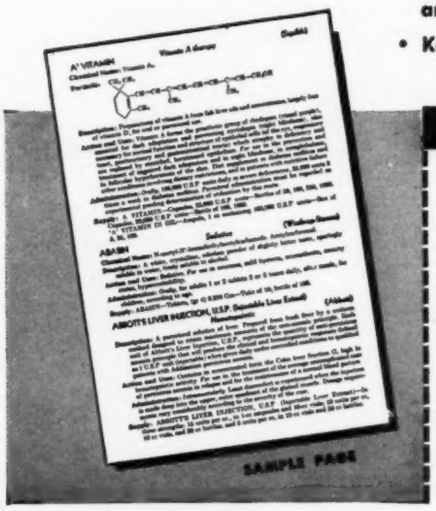


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WHEN it's life or death in surgery, no equipment, including gloves, can be too good. That's why so many hospitals and surgeons specify Pioneer Rollprufs. They know they're getting bare-hand comfort, working freedom and finger tip sensitivity that no other quality surgical glove can match.

All Rollprufs, rubber or neoprene, have the exclusive advantage of beadless, flat-banded wrists that won't roll down and annoy during surgery—reduce tearing. It pays you to insist on Rollprufs. Specify the gloves that help to better surgery and make your budget go further. Ask your supplier for Rollprufs today—or write The Pioneer Rubber Company, 753 Tiffin Road, Willard, Ohio; Los Angeles, California, U.S.A.

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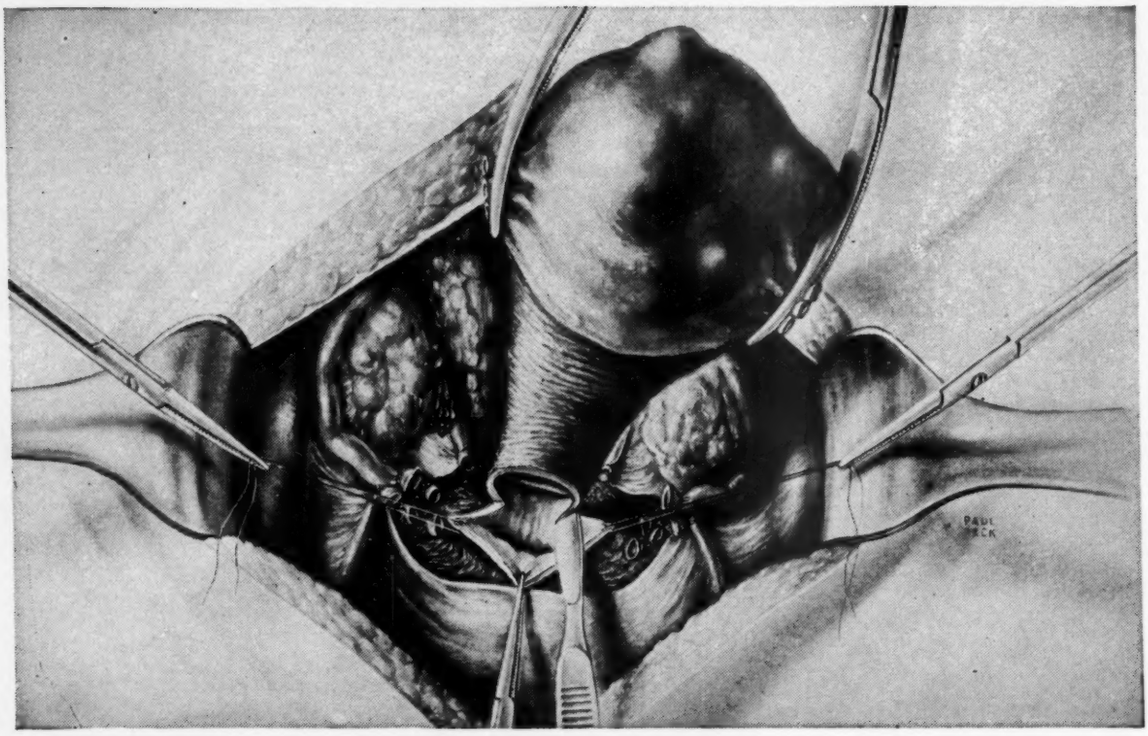
| PROTEIN | 32 Gm. | VITAMIN $B_1$ | 1.16 mg. |
| FAT | 32 Gm. | RIBOFLAVIN | 2.0 mg. |
| CARBOHYDRATE | 65 Gm. | NIACIN | 6.8 mg. |
| CALCIUM | 1.12 Gm. | VITAMIN C | 30.0 mg. |
| PHOSPHORUS | 0.94 Gm. | VITAMIN D | 417 I.U. |
| IRON | 12 mg. | COPPER | 0.5 mg. |

**Based on average reported values for milk.*



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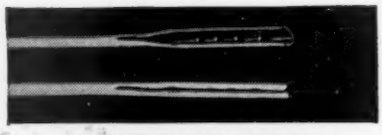

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# Editorial

## CARCINOMA OF THE LUNG

UNTIL recently the outlook for patients with lung carcinoma was hopeless. With the advent of intratracheal anesthesia the hazard of surgery of the open chest has been eliminated. The operative mortality now depends on the type of surgery rather than upon the physiologic disturbances resulting from uncontrolled respiration attendant upon an open pneumothorax.

Simple pneumonectomy, or the removal of a lung, for carcinoma is now a standardized procedure. Individual ligation of vessels at the hilum, with suturing of the bronchus and pleuralizing of the stump is the procedure now universally employed.

A tumor that has progressed into the mediastinum, either by direct extension or through involvement of regional lymph nodes, should be handled by block dissection of the mediastinum. This radical procedure is indicated when the disease has not been diagnosed early enough to permit early exploration. That this is worth while is attested by the five-year survival in about 6 per cent of cases with mediastinal involvement. Similarly, chest wall, pericardial or diaphragmatic involvement does not necessarily contraindicate resection. From the surgical standpoint, a more and more radical approach to the problem of lung carcinoma is to be advocated if a higher five-year survival is to be attained.

Frequently the diagnosis of carcinoma cannot be confirmed except at operation at which time the tumor may have progressed beyond the point of operability. It cannot be too strongly emphasized that carcinoma must be suspected before a diagnosis is made, and in many cases x-ray examination will afford the only means of suspecting the disease. An exploratory thoracotomy on the basis of a suspicious x-ray shadow in the absence of other evidence of malignancy will result in a higher incidence of cure than if operation is delayed until the diagnosis is established.

Peripherally situated tumors usually present no symptoms until they have undergone regional or distant metastasis. They may be discovered on routine chest x-ray examination. Bronchoscopy will reveal no mass to biopsy. Cases with completely negative bronchoscopy have a higher resectability rate (44 per cent) than those with suggestive bronchoscopy and negative biopsy (18 per cent) or with positive biopsy (36 per cent). Peripherally situated tumors are frequently of the adenocarcinoma type and as a rule metastasize through the blood stream rather than by way of the lymphatics. Because of their situation in the lung resection is more successful than in the case of the more centrally located tumors although the five-year

survival will depend upon the extent of the disease at the time of operation.

A tumor situated at the hilum, on the other hand, is likely to produce symptoms while it is still small in size. Bleeding is frequently noted and also wheezing due to partial blocking of the bronchus by the tumor. Recurrent episodes of "pneumonia," "slowly resolving" pneumonia, and pneumonia with central necrosis and abscess formation are characteristic of this type of carcinoma and represent various degrees of occlusion of the bronchus by the tumor with impairment of the blood supply.

X-ray examination will reveal a hilar shadow of increased density with peripheral obliteration of the lung distal to the blocked bronchus. Bronchoscopy will result in positive biopsy if the mass is in the main bronchus or in the secondary branch bronchi of the lower or middle lobe. Retrograde mirror bronchoscopy will be necessary to visualize tumors in the upper lobe, and these can be seen only when they are close to the mouth of the orifice. A tumor situated at the hilum but outside the bronchial tree will not be visualized directly, but may be suspected from the appearance of the bronchus adjacent to the tumor. Compression or invasion of the bronchus from without or widening of the spur as is seen in involvement of the carinal node suggests either direct extension or metastatic nodes.

Such tumors are usually either of the squamous cell or undifferentiated cell type. They may therefore be either the slow growing or the rapidly invading type of tumor. Initial spread will occur through the lymphatics. Because of the proximity of the tumor to vital structures such as the aorta, the superior vena cava and the heart, a slight extension of the process which may occur in a very short period of time may be sufficient to render the condition inoperable.

X-ray is of paramount importance in bringing peripheral tumors to operation because this may be the only means of diagnosis. In the case of hilar tumors serial x-ray pictures will reveal the progressive changes which distinguish carcinoma from other types of pulmonary suppuration. It should be remembered, however, that the feasibility of resection cannot be predicted by x-ray unless there is obvious metastasis beyond the thorax. Similarly, bronchoscopy, although of considerable importance, is only an adjunct to diagnosis. Sputum examination for malignant cells has recently been brought forward as another means of diagnosis prior to exploration. This method plays an important part in early diagnosis of malignancy, especially in those cases beyond the range of the bronchoscope, that are situated near the hilum. Peripheral tumors are less likely to have malignant cells in the bronchial washings, so that they should be explored with negative cell examination.

The responsibility of the medical profession, therefore, is obvious. First, the diagnosis of lung carcinoma should be suspected in order to bring the case to early operation. Secondly, the surgical approach should be as radical as extension of the disease will require.

ADRIAN LAMBERT, M.D.

# Original Articles

## ECTOPIC PREGNANCY*

### I. WITH SPECIAL REFERENCE TO ABDOMINAL PREGNANCY

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Director of Obstetrics and Gynecology, Sydenham Hospital; Director of Gynecology, Hillside Hospital

*New York, New York*

ECTOPIC pregnancy, extra-uterine pregnancy or eccyesis is the existence of an embryo or fetus outside the uterine cavity. While the term "extra-uterine" is more commonly employed to signify this condition, the expression "ectopic," originated in 1873 by Robert Barnes, is the broader and more widely inclusive designation. It comprises those gestations where the ovum lodges and develops in the interstitial portion of the tube as well as all other gestations that develop in locations outside the body of the uterus. In this work the terms extra-uterine and ectopic will be used interchangeably. (Fig. 1.)

#### HISTORY

The subject of extra-uterine pregnancy is one of the most interesting in the entire realm of obstetrics. This type of gestation is not mentioned in the extant Greek and Roman medical literature. What is believed to be the first reference to abdominal pregnancy is found in that great rabbinical treasure-house, the Talmud. We read that the rabbis of the Talmud observed a child "which emerged from the abdominal side of the mother." They called the infant "Joze Dofan." In their opinion, such a child can be born alive and they "maintain that both mother and child survive in such cases" (Ploss, Bartels and Bartels).

Among the Buddhists we find mention of a "peculiar form of extra-uterine pregnancy outside the womb." According to their legend, the boy Buddha "was born through the right side or the armpit of his mother" (Köppen).

Abdominal pregnancy is of special historical interest because it was apparently the first type of extra-uterine gestation to be recognized.

Many years prior to 1717, when the first diagnosis of full term abdominal pregnancy was made by Robert Houston, lithopedions and abdominal fetuses had been observed and described. In fact the early history of extra-uterine pregnancy refers particularly to the operative removal of full term or long-retained secondary abdominal pregnancies.

Most writers attribute the first recorded case of intra-abdominal pregnancy to Albucasis (1013–1106), the distinguished Arabian physician of Cordova. His great work, "Al Tasrif," an encyclopedia of medicine, contains a treatise on surgery which is one of the best that has come down from the Middle Ages.

Albucasis describes the case of a pregnant woman whose fetus died without being expelled. The woman became pregnant again and the second fetus also died. At a later date an umbilical abscess developed with subsequent rupture and the expulsion of a "large number of small bones." The patient recovered but the fistulous tract remained (Ricci). This case affords an excellent example of an old, long-retained, secondary abdominal pregnancy.

Many other interesting examples of ectopic pregnancy are scattered throughout the early records. Schumann, in his monograph entitled "Extra-Uterine Pregnancy," refers to an interesting example of ectopic gestation known as the famous lithopedion of Sens. This was reported by Cordaeus in the early part of the sixteenth century and undoubtedly refers to the same patient mentioned by William Campbell in his treatise, "A Memoir on Extra-

* From the Department of Obstetrics and Gynecology, Sydenham Hospital, New York, N. Y.

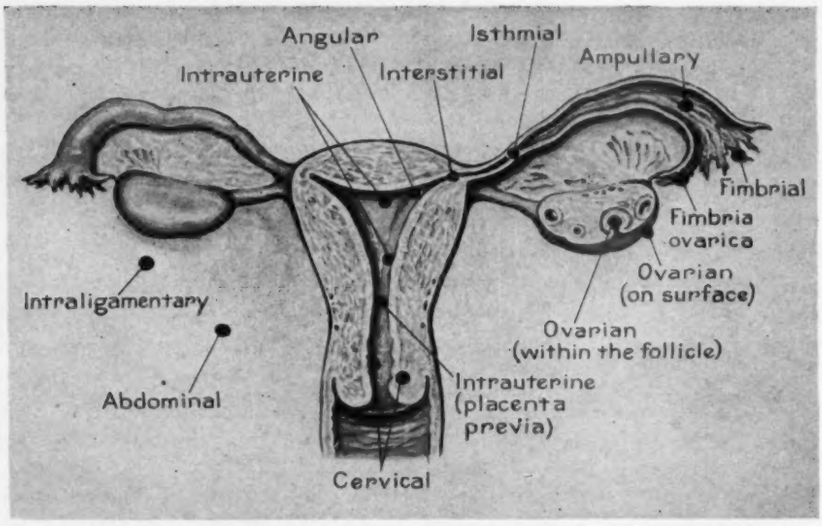


FIG. 1. Schematic drawing of coronal section through the uterus, left fallopian tube and left ovary indicating the possible sites of pregnancy.

Uterine Gestation." According to Campbell's account, the patient had been married many years but had remained sterile until the age of forty. When she died at the age of seventy-one years, a "foetus encased in a stoney crust" was removed.

Following are a number of other noteworthy cases presented by Campbell, among them being that of Cornax who "dilated an ulcer which formed near the umbilicus, and extracted a semi-putrid foetus, which had been retained for nearly five years."

Felix Platerus reports a case of a concubine from whose abdomen a semiputrid fetus was extracted. The patient survived the operation for one year.

In 1540, according to Donatus, Christopher Bain, a travelling surgeon, performed a laparotomy for the removal of a long-retained fetus. In all probability this operation was for ectopic gestation. It was successful and the patient recovered and shortly thereafter had other children born "in good condition."

In the latter part of the sixteenth century Horstius reported the case of a woman who, in 1563, had the remains of a fetus still in her abdomen where they had been since 1549.

James Primerose reported a classical case in which a patient conceived twice with extra-uterine pregnancies, the first occurring in 1591 and the second some time in 1594. According to Schumann, Primerose's work represents the earliest definite report of a laparotomy for the removal of an abdominal fetus. He states that "the cyst of the first child opened spontaneously through the abdominal wall. The fistula was enlarged, and this child extracted by Jacob Noierus, a surgeon." As this operation proved successful, the second infant was removed two months later by celiotomy.

Also reported in the sixteenth century (1560–1624) are the classical cases of Jacob Nufer and Christopher Bain. Bovee, who cites these cases, says that it is thought probable that Nufer performed the first abdominal section for extra-uterine pregnancy although his operation is considered as the first case of cesarean section on a living woman. The report appears in the collection of Caspar Bauhin and is recorded in Von Siebold's History of Obstetrics. "According to the relation of Caspar Bauhin, in his appendix to the Latin translation of Fr. Rousset's writings upon Cesarian section, Jacob Nufer, a swine-spayer, at Sigerhausen, in Switzerland, in the year 1500, delivered his own wife by opening the abdomen, and the operation proved successful for both mother and child."

Titus is of the opinion that many of the successful cesarean sections reported in the early literature were probably "crude laparotomies for the removal of secondary abdominal pregnancies."

What appears to be one of the earliest recorded cases of tubal gestation was recorded in 1604 by Riolanus the younger. The patient developed the classical symptoms of tubal rupture and died. An autopsy revealed that the right fallopian tube contained a fetus while the uterus appeared to be healthy and

normal. This author reports a similar case in 1638 where autopsy findings revealed a fetus in the left fallopian tube.

In 1669 Mauriceau presented plates and a painstaking description of a ruptured extra-uterine pregnancy which he had observed personally. Although his description of the case was excellent, his deductions concerning it gave rise to bitter controversy. He did not believe it to be a true tubal gestation but considered it to be a hernia from the right horn of the uterus. However, it was undoubtedly an extra-uterine gestation but whether it was tubal or interstitial is open to doubt.

The possibility of ovarian pregnancy was suggested as early as 1614. Most authors, however, attribute the first diagnosis of such a case to de St. Maurice in 1682. In 1899 Catherine van Tussenbroek published a histologic description of what is regarded as the first authentic case of ovarian pregnancy. This case demonstrated beyond question that the ovum could be embedded in the ovary.

The first record of simultaneous extra-uterine and intra-uterine pregnancy was that of Duverney in 1708 (Garrison). In his "Treatise of Midwifery," published by Pierre Dionis in 1718, we find the first clear description of interstitial pregnancy and a discussion of the cause of extra-uterine gestation. Of the cause of "foetus's form'd out of the womb" Dionis says: "If the egg is too big, or if the Diameter of the *Tuba Fallopiana* is too small, the Egg stops, and can get no farther, but shoots forth, and takes root there; and having the same Communication with the Blood-Vessels of the *Tuba*, that it would have had with *those* of the Womb, had it fallen into it, is nourished, and grows big to such a degree, that the Membrane of the *Tuba* being capable of no such Dilatation as that of the Uterus, breaks at last, and the *Foetus* falls into the Cavity of the *Abdomen;* where it sometimes lies dead for many Years, and at other times occasions the death of the Mother, by breaking open its Prison."

The author advances the belief "that it is most certain that Infants are form'd in the *Tuba*, as well as in the Womb." Dionis did not recognize salpingitis as a cause of tubal obstruction.

The first operation for extra-uterine pregnancy in America was recorded by John Bard of New York. He described the case in a letter dated December 25, 1759. The patient recovered.

William Baynham performed the second American operation in 1791 and also reported a similar operation which he performed in 1799. Both were cases of extra-uterine conception. The first was that of a fetus grown to full size and maturity which had been retained for more than ten years. In each instance the fetus was extracted successfully.

In the third operation of this type Charles McKnight was the surgeon. The case was reported by Mease of Philadelphia in 1795. According to Renner McKnight was the first to leave the placenta *in situ*. The operation was successful.

A remarkable operation for abdominal pregnancy was performed early in the nineteenth century by John King of South Carolina. King cut through the walls of the vagina and delivered the child by forceps, thus saving the lives of both mother and child (Welton, 1927).

The first American operation for "tragic" ruptured ectopic gestation was performed by Charles K. Briddon, of New York in 1883.

Early in the nineteenth century interest in the subject began to show a decided increase and a number of important monographs was published. In 1837 Dezeimeris published his outstanding classification in which he made a new arrangement of the various types of ectopic gestation and gave a careful description of the pathologic processes present. William Campbell's treatise, published in 1840, stands as a true landmark in the literature of the subject. In 1876 John S. Parry's excellent monograph, "Extra-Uterine Pregnancy," was published. Of this work Lawson Tait says: "It is at once remarkable for its scholarly research and fine critical sagacity." Parry collected 500 instances of extra-uterine pregnancy from various sources and his monograph is based upon an analysis of these cases. His work inspired particular interest in the pathology and treatment of extra-uterine pregnancy and represents a distinct forward step in an understanding and appreciation of this unfortunate accident.

In 1883 Robert Lawson Tait became the first to operate successfully for ruptured tubal pregnancy and to establish the operative technic for this condition. A pioneer in many phases of operative gynecology, Tait had been asked during the summer of 1881, to see a

patient whose condition had been diagnosed as that of tubal rupture with internal hemorrhage. It was suggested frankly that he "should open the abdomen and remove the ruptured tube." He agreed with the diagnosis but, nevertheless, he refused to operate; another hemorrhage proved fatal to the patient. Postmortem examination revealed that the diagnosis had been perfectly accurate. After injecting the excised specimen, Tait concluded that if he had tied the broad ligament and removed the ruptured tube, he could have arrested the hemorrhage and thus, in all probability, could have saved the patient.

In 1883 Tait did operate on a patient with a ruptured tubal pregnancy. Although the patient died, he attributed his failure to faulty technic. In spite of his keen disappointment in the fatal outcome he continued to operate for this condition and he lost but one of the next forty patients. Tait strongly advocated surgical intervention for extra-uterine gestations. As a result of his great ability and remarkable operative skill he enjoyed a high degree of success in his entire series of cases. In his "Lectures on Ectopic Pregnancy and Pelvic Haematocele," published in 1888, he presented a simple classification of ectopic pregnancies. He maintained that ovarian gestation was possible but had not been proved. While opinions differ widely on the site of implantation, a consensus of opinion on this aspect of the matter indicates that by far the greatest number of ectopic pregnancies is to be found in the tube. Tait says: "I believe that they are really all tubal, and in this consists the novelty of my views on the subject." He was of the opinion that interstitial ectopic pregnancy was very rare, "and that form which occupies the free part of the tube must have an overwhelming preponderance, and the other alleged forms I have yet to see."

Tait was the first to work out the pathology and treatment of pelvic hematocele. His lectures are classical and his views on this subject are generally accepted by the medical profession.

In 1891 Schauta demonstrated the importance of operative treatment. He compared 123 patients operated upon with 121 patients treated palliatively, with a mortality of 5.7 and 86.89 per cent, respectively. Because of the great improvement in operative procedures during this period, surgical treatment for ectopic pregnancy became better established and gradually took its place as the procedure of choice among many surgeons. Thus, many lives were saved that otherwise might have perished.

All authorities acknowledge the brilliant work of Werth whose pioneer investigations were published in 1887. His continued interest in this subject resulted in a further contribution in 1904 which became an outstanding part of von Winckel's "Handbuch." By way of tribute to Werth's distinguished work entitled "Beiträge zur Anatomie und zur Operativen Behandlung der Extrauterinschwangerschaft," Kelly comments: "The dawn of a new era in the critical examinations of the specimens dates from the work of Prof. Werth of Kiel." Anspach states that Werth's studies on ectopic pregnancy "embraced both the laboratory and the clinical side. His deductions and teachings have remained for the most part unchallenged."

## COMPARATIVE ANATOMY

"Extrauterine pregnancy in domestic animals provides a highly confusing medley of truth and error," (Walter L. Williams).

Although it is generally admitted that this anomaly in domestic animals is possible, and while its occurrence has been recorded, a painstaking search of veterinary literature reveals that true ectopic gestation in animals is extremely rare and much less frequently encountered in them than in the human subject. The reasons for the rarity of this condition in animals may well include: (1) difference in mode of life; (2) restriction of generative organs to reproduction; (3) low incidence of disease, deformities and functional abnormalities in animals.

Our highly complex social order must receive a large share of the responsibility for the pelvic inflammatory diseases which play so important a role in ectopic gestation. Gonorrheal salpingitis and abortion are the most frequent offenders in this condition.

It may be assumed that the generative organs of animals serve but one purpose, that of reproduction. Coitus in animals is free from the use of contraceptive devices which in themselves may be a contributing factor in ectopic pregnancy. Animals are not subject to pelvic and abdominal surgical manipulations

similar to those which cause adhesions in the human female and interfere with the normal, unobstructed progress of the ovum to the uterus which may bring about extra-uterine implantation.

Campbell, in 1840, and George Fleming, in 1889, collected early references to extra-uterine pregnancies in animals. Campbell's cases date back to the sixteenth century and include a description of a cow "which conceived again during the retention of the extra-uterine calf . . . The bones . . . must have passed from the abdominal cavity, as it is not very likely that the animal would have conceived with a decomposed foetus in her uterus . . . Cases of this nature are recorded which occurred during the seventeenth century in a bitch . . . and in a sheep." This author states also that cases are recorded of extra-uterine pregnancy in a hare.

While tubal gestation is believed to be exceedingly rare in animals, Fleming cites several early investigators who refer to this anomalous condition. Rohlwes tells of having found fetal bones in an animal's left fallopian tube and Carus states that this type of pregnancy has been observed in the rabbit. Because the tube is incapable of distending sufficiently for the development of the fetus, Carsten Harms refers to tubal gestation as causing fatal internal hemorrhage by rupture of the tube.

Fleming's research would indicate also that ovarian implantation has seldom been observed although it is not at all impossible for it to occur in domestic animals. Rohlwes observed this rare form of gestation in a mare which had been pregnant twenty-one days. Plot noted it in a cow and in three sows. Fleming believes that interstitial gestation has not been noted in the lower animals but he states that abdominal pregnancy, while extremely rare, has been recorded.

Thiernesse reports an authenticated instance of simultaneous, normal uterine gestation and primary abdominal extra-uterine pregnancy in a sow. Details of this unusual case, including a pathologic report, were published in 1871 in *Annales de Méd. Vétérinaire de Bruxelles.*

In humans there are numerous cases recorded in which the fetus has been retained in the abdomen for many years. In animals also the fetus may be retained for long periods. Simon reports the case of a ewe which had carried a dead fetal formation for two years; apparently this was a case of primary extra-uterine abdominal gestation. When the lamb was due to be delivered, the ewe experienced spurious labor. A veterinary made futile attempts to extract the fetus. For several days the mammary glands were enlarged and the ewe was sick and feverish. The symptoms disappeared gradually and the animal was restored to health. Two years later, much to the astonishment of the owner, the ewe brought forth a lamb, the product of a normal intra-uterine gestation. Shortly thereafter the ewe was butchered and the extra-uterine fetus was removed from the abdominal wall. This unusual case of compound pregnancy is interesting because its symptoms and course are identical with those in woman.

Several other cases of ectopic gestation in animals have been recorded including one of twin secondary abdominal pregnancy reported by S. Della-Rovère.

Bland-Sutton's important studies, completed in 1904, failed to disclose a single convincing record or specimen of tubal pregnancy but did report relatively frequent cases "in which puppies and kittens enclosed in tightly fitting sacs have been found adherent to the omentum and intestines."

Although some of these cases had been accepted by pathologists as primary abdominal pregnancies, Bland-Sutton designated them as "utero-abdominal pregnancies," and set forth his conclusions in a form yet to be disproved by subsequent writers. By dissection Bland-Sutton learned that rupture of the uterus was the major cause of abdominal pregnancy. He observed that in mammals with two-horned uteri each horn might contain several embryos. When these fetuses are too large to traverse the maternal passage, they may be extruded into the abdomen by reason of violent expulsive movements of the uterus, causing rupture of that organ.

Rabbits, cats and dogs are more susceptible to uterine rupture under these circumstances than are other animals. A somewhat tenuous analogy may be drawn between ectopic pregnancy in the fallopian tubes in women and cornual pregnancy in animals in that axial rotation may take place in each.

While the tubes apparently are the site of fertilization in lower animals and have been

suspected as the location of ectopic pregnancy by some writers, there are but a few recorded cases. Waldeyer reports an undoubted case of tubal pregnancy in an ape that died suddenly in the zoo and was dissected and examined very shortly after death. This is probably the best known case of tubal pregnancy in an animal. Other tubal pregnancies mentioned in the literature occurred in a cow and in a pig.

In 1898 Mandl and Schmit stated that they had observed ectopic pregnancies in the pig, dog, cow and horse. Most of these cases were believed to be secondary abdominal gestations.

Blair-Bell states that while primary ectopic pregnancies are of extreme rarity in animals, secondary abdominal gestations are fairly common, especially in hares and rabbits. He is of the opinion that such pregnancies are caused by the rupture of the uterine cornua, followed by the gradual extrusion of the fetus into the abdominal cavity. In some instances the placenta maintains its original site. He reports a case in a rabbit which he believes was an instance of primary abdominal pregnancy. After careful study of this case he concluded that primary abdominal implantation can take place in lower animals.

Tubal diverticula initiated by pathologic changes have been advanced as one of the causes of tubal pregnancy. Kök states that diverticula occur in 20 per cent of the tubes of swine. He believes, too, that mechanical disturbance in the transportation of the ovum is of etiologic significance in tubal pregnancies. However, he found only two cases of tubal pregnancy in swine reported in the literature.

According to Dorland and Bartelmez a study of mice and guinea pigs indicates that the decidual reaction begins to appear only after the developing ovum has corroded the superficial epithelial layers of the endometrium.

Tubal diverticula and the presence of favorable soil (decidual reaction) in the tube favor tubal implantation of a fertilized ovum not only in human beings but also in some animals.

Observations upon animals and humans would indicate that under normal conditions the spermatozoa gain access to the fallopian tubes promptly. Fertilization then takes place, usually in the outer third of the tube.

Kelly says that among lower animals fertilization of ova takes place in the tube, probably the upper part; the fertilized ovum is then carried to the uterus by the action of tubal cilia. In the presence of pathologic changes decidua may form and the ovum may become nested in the oviduct instead of the uterus.

In most animals, from the mouse to the cow, the time necessary for a fertilized ovum to pass from the ovary to the uterus is approximately three days. In the case of the monkey three days are required also and, according to Hartman, there is no reason why the process should take longer in the human subject.

Various estimates have been promulgated regarding the viability of the ovum and spermatozoon. In all probability the ovum perishes soon after it leaves the ovary. The life of the spermatozoon is extremely short in some animals while in others it may live for several months. It has been possible to keep human spermatozoa alive in test tubes for at least a week. If they remain in contact with vaginal secretions, however, they die within a few hours following coitus. On the other hand, they have been recovered from the uterus and tubes as long as two weeks after coitus.

Most authorities believe that the fertilized ovum is carried to the uterus by the ciliary current and also by means of peristaltic action of the tubal musculature. At the time the ovum is extruded from the graafian follicle, the fimbriated end of the tube assumes unusual activity and its cilia sweep the ovum into the ampullary portion of the tube whence it is propelled by peristaltic action to the uterus.

Working with rabbits and using corpus luteum hormone to stimulate decidual reaction, Fred L. Adair found decidua essential "before implantation can take place but it is doubtful whether decidua is necessary for implantation in the human." Attempts to cause the development of an ovum in a normal tube by ligating the uterine end immediately after fertilization have been unsuccessful for the most part.

While Walter L. Williams recognizes the possibility of primary extra-uterine pregnancy in animals, he is of the opinion that most cases of ectopic gestation are secondary implantations, the result of rupture of an intrauterine nidation with concomitant fetal death. In cases of this type the veterinarian frequently observes a tear in the uterus, cervix or vagina, obviously the avenue of escape into the abdominal cavity. Usually these cases are the result of transverse uterine rupture caused by torsion.

INCIDENCE

During the fourteen-year period under study (1934–1947) the incidence of ectopic gestation in the Sydenham Hospital was as follows: Intra-uterine pregnancies 11,893; ectopic pregnancies 173; giving a ratio of 1:69; gynecologic admissions 7,726;* ectopic pregnancies 173; giving a ratio of 1:44; combined obstetric and gynecologic admissions 19,619; ectopic pregnancies 173; giving a ratio of 1:113.

According to Schumann, the corrected figures for the city of Philadelphia in the year 1918 read: Intra-uterine pregnancies 56,441; extra-uterine pregnancies 186; giving a ratio of 1:303.

In 3,747 ward cases at the Jefferson Hospital, Philadelphia, ectopic pregnancy was encountered eighty-three times, or once in forty-five cases.

Crossen and Crossen report an average incidence of approximately one ectopic pregnancy in every 200 cases of pregnancy and in about 2 per cent of gynecologic cases.

According to Stander of 34,356 obstetric cases reported from the New York Lying-In Hospital, 128 were ectopic pregnancies, giving an incidence of one ectopic in 268 pregnancies.

Nucci reports that in 31,783 obstetric cases in his series there was an incidence of one ectopic pregnancy for every 212 intra-uterine pregnancies or, roughly, a ratio of 1:200. This author reports that of 10,242 gynecologic admissions, 1.46 per cent was for ectopic pregnancy.

*Age.* Our patients ranged in age from sixteen to forty-five years as indicated in Table 1.

TABLE 1

| Ages | No. of Cases | Per Cent |
|---|---|---|
| 16–20 | 5 | 2.9 |
| 21–25 | 42 | 24.3 |
| 26–30 | 58 | 33.5 |
| 31–35 | 49 | 28.3 |
| 36–40 | 15 | 8.7 |
| 41–45 | 4 | 2.3 |
| | 173 | 100.0 |

The largest single age group was in the five-year period from twenty-six to thirty years of age in which there were fifty-eight cases (approximately 33.5 per cent). In the age groups from twenty-six to thirty-five there were 107 patients (62 per cent); 164 cases (95 per cent) occurred in the third and fourth decades.

In the series of 310 cases presented by Langman and Goldblatt, 292 (94 per cent) occurred during the third and fourth decades; 175 (56 per cent) occurred between the ages of twenty-five and thirty-five.

Marchetti et al. report 141 cases in which 135 (95.8 per cent) occurred during the third and fourth decades while eighty-two (58.2 per cent) ranged from twenty-five to thirty-four years of age. In Ware and Winn's study in 1941 of 150 consecutive cases 134 (89.3 per cent) occurred during the third and fourth decades and seventy-seven (51.3 per cent) between the ages of twenty-five and thirty-five. In Torpin's eighty cases, reported in 1944, seventy-five (94 per cent) occurred during the third and fourth decades and forty-one (51 per cent) ranged in age from twenty-five to thirty-four. Woodhouse reports seventy-three cases in which sixty-five (89 per cent) occurred during the third and fourth decades while thirty-eight (52.1 per cent) ranged from twenty-five to thirty-four years of age. In Schauffler and Wynia's sixty-five cases there were fifty-nine (91 per cent) in the third and fourth decades and twenty-seven (42 per cent) ranging in age from twenty-five to thirty-five.

*Gravidity.* Among the cases included in this series sixty-five patients had not been pregnant previously; 108 had been pregnant from one to eight times and there was a total of 391 pregnancies, including the present ectopic. The statistics in detail are presented in Table II.

TABLE II

| Previous Pregnancies | No. of Patients | Per Cent |
|---|---|---|
| 0 | 65 | 37.6 |
| 1 | 49 | 28.3 |
| 2 | 31 | 17.9 |
| 3 | 16 | 9.2 |
| 4 | 7 | 4.0 |
| 5 | 2 | 1.2 |
| 6 | 1 | 0.6 |
| 7 | 1 | 0.6 |
| 8 | 1 | 0.6 |
| | 173 | 100.0 |

* Includes 173 cases of ectopic pregnancy.

*Abortions.* In this series the number of abortions is indicated in Table III.

TABLE III

| Abortions | No. of Patients | Per Cent |
|---|---|---|
| 0 | 118 | 68.2 |
| 1 | 42 | 24.2 |
| 2 | 10 | 5.8 |
| 3 | 1 | 0.6 |
| 5 | 1 | 0.6 |
| 6 | 1 | 0.6 |
| | 173 | 100.0 |

From the histories of the patients one gets the general impression that abortions, in all probability, were more numerous than these figures would indicate. However, it is always difficult to elicit a history of abortion. Many patients conceal this fact intentionally while others tend to forget it.

## ETIOLOGY

The many generally accepted causes of ectopic gestation and the wide variation of the relative importance which leading authorities ascribe to them are adequate evidence of the uncertainty which surrounds the etiology of this subject and of the need for further energetic investigation. Especially striking is the marked divergence of opinion regarding the importance of what seem to be universally accepted causative factors. The opinions of individual investigators often seem to be strongly colored by personal experience, *i. e.*, the physician whose practice is composed almost exclusively of women from the wealthier social strata will not find salpingitis of gonorrheal origin a leading offender in his cases of ectopic pregnancy, whereas a man whose practice is of a heterogeneous urban character will consider tubal inflammatory disease of prime etiologic importance.

Sound anatomic and histologic study of the subject is impeded by hemorrhage and by the secondary changes that result from the growth of the ovum. These conditions obscure or obliterate the causes which existed at the time of the unnatural implantation. Despite this it is incumbent upon the surgeon to insist upon a searching pathologic report which will throw light on the causative factors in each case.

The four types of ectopic gestation, in order of frequency are: (1) tubal; (2) ovarian; (3) abdominal; (4) cervical. Tubal pregnancies far outnumber all the other types.

In reviewing the literature beginning with the contributions of Lawson Tait (1888), one is impressed by two observations made by the vast majority of workers. First, tubal implantation, the most frequent type of ectopic gestation, is caused by some factor, usually mechanical, which prevents the fertilized ovum from completing its passage through the tubal lumen to the uterine cavity. Second, this tubal barrier is frequently the result of pelvic inflammatory disease, often of gonorrheal origin.

Many authorities support the theory that pelvic inflammatory disease with its mechanical sequelae is a causative factor. Curtis says, "In the majority of instances the direct cause is a mechanical interference with the passage of the ovum," and he draws special attention to perisalpingitis and interstitial salpingitis which often follow instrumental abortion.

Kelly maintains that ectopic gestation is caused by obstruction to the passage of the fertilized ovum in the tubal lumen. He says, "Possibly the thickening of the tubal walls accompanying marked salpingitis facilitates the arrest of the ovum by interfering with the peristaltic movements and choking the lumen.

"Of still greater importance is the thickening and agglutination of mucosal folds serving to entrap the fertilized ovum during its tubal transit. Whatever explanation, chronic salpingitis undoubtedly does act as a prolific predisposing cause." (Figs. 2 to 8, Case II.)

Novak (1944) considers that factors which interfere with the transit of the ovum down the tube constitute the most important causes of ectopic gestation. He states that chronic salpingitis is the cause most often concerned because of its mechanical action in partially blocking the tube and because of its interference with ciliary activity and peristalsis. He says, "The egg does not implant itself until its burrowing apparatus, the trophoblast, has developed, and this normally takes place after the egg has reached the uterus. For this reason I believe the retardation of its progress is probably the chief factor in tubal pregnancy, permitting the development of the trophoblast while the egg is still in the tube."

Schumann maintains that the cause is some

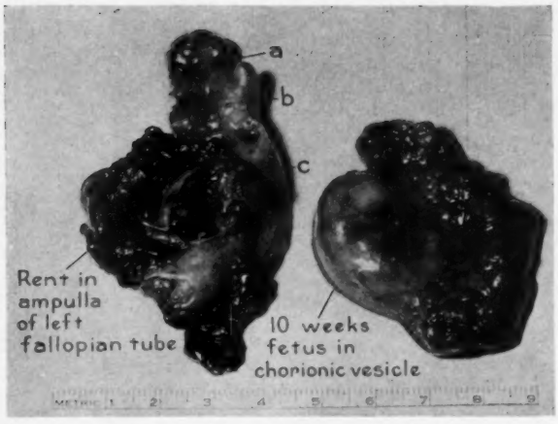


FIG. 2. Case 11, J. M. A photograph of ruptured left tubal pregnancy measuring 6 by 3 by 0.5 cm. Approximately 2.5 cm. from the fimbriated end there is a rupture of the tube from which a fetus measuring 3 cm. in its chorionic vesicle was taken; menstrual age ten weeks.

interference with the descent of the ovum through the tube to the uterus. He believes that gonorrheal salpingitis is the factor most often encountered as an internal obstruction.

A histologic study was made of 129 of the 173 patients in this series with the following results: Acute salpingitis four cases (3.1 per cent); chronic salpingitis fifty cases (38.8 per cent); acute and chronic salpingitis fourteen cases (10.9 per cent); negative for salpingitis sixty-one cases (47.2 per cent). In forty-four patients who showed gross anatomic evidence of pregnancy, microscopic examination was not done because of wartime exigencies.

In his contribution to the etiology of ectopic gestation C. D. Williams states that at least 95 to 98 per cent of ectopic pregnancies are caused by diverticula, the sequelae of salpingitis. He says that every specimen which he examined microscopically from the gynecologic service of a large urban hospital revealed a bilateral, pre-existing inflammatory process.

In the majority of Polak's cases there was a history of previous inflammatory infection. Tyrone et al. in their study of 309 cases found salpingitis either grossly or microscopically in 37.5 per cent of the patients. In their statistics covering 141 cases of ectopic gestation in a large city hospital Marchetti et al. report a definite history of previous pelvic infection in 26.9 per cent. Langman and Goldblatt, in a study of 310 cases of ectopic pregnancy operated on in a large metropolitan hospital, report that less than 20 per cent had a history

FIG. 3. Case 11, J. M. Photomicrograph, low magnification. Section was made through proximal end of tube (see *a* in Fig. 2). Shows chronic salpingitis; no decidual reaction; no chorionic villi.

of pelvic infection but microscopic examination raised the incidence to more than 50 per cent. Usually the inflammation was chronic. Burch and Seitchik found that patients quite commonly gave a history of some pelvic inflammatory disease or infection following labor or abortion or of infection following an operation for ruptured appendix.

In my series of cases either a clear or a suspected history of previous inflammation of the adnexae was evidenced. Many cases of chronic salpingitis were due to gonorrhea. In the study of any woman who has had an ectopic pregnancy one must not overlook the male partner since the ultimate cause may be an inapparent prostatitis or urethritis. Often these infections in the male were contracted many years previously. Thus, the history which the patient presents may lack the essential fact which provides the explanation. (Figs. 3 and 4, Case 11.)

Some investigators ascribe little or no importance to pre-existing inflammation as a cause of ectopic pregnancy. Foskett found

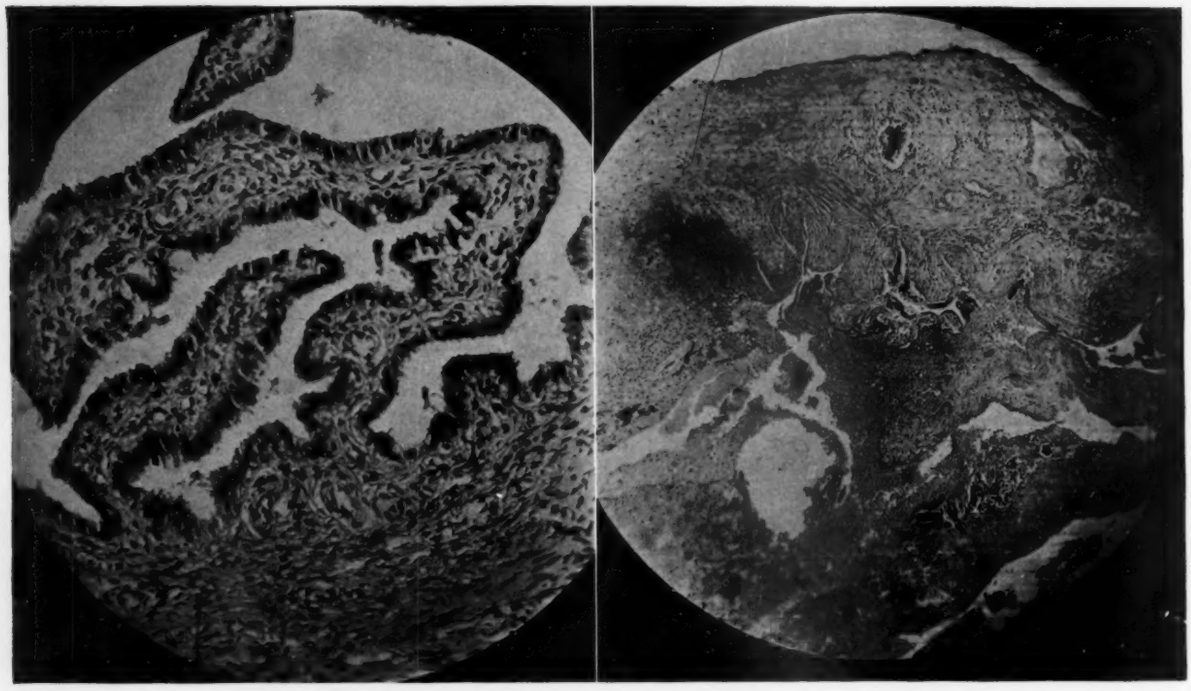

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FIG. 4. Case II, J. M. Proximal end of tube, higher magnification of field shown in Figure 3.
FIG. 5. Case II, J. M. Photomicrograph, low magnification. Sections taken from point nearer to ruptured portion of tube (see *b* in Fig. 2) showed decidual reaction.

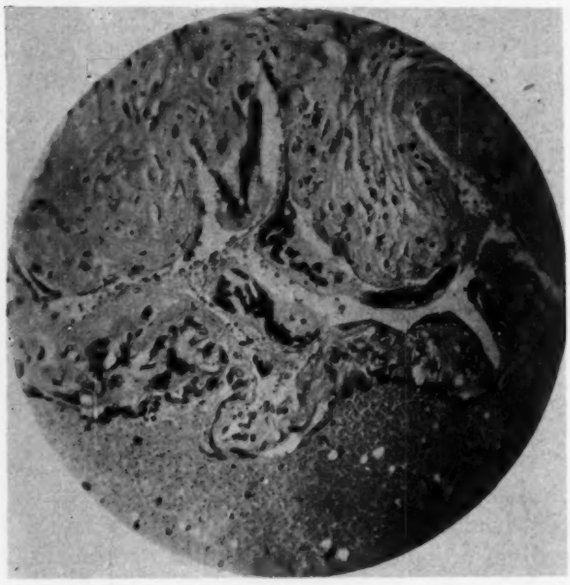

FIG. 6. Case II, J. M. Higher magnification of field shown in Figure 5.

that one-third of his series of 117 patients had had abortions. He believes that abortions and their sequelae are more important than venereal disease as causative factors.

A definite cause could be found in only about one-third of Oastler's series of 106 cases. Oastler believes that if a pre-existing inflammation were the only cause, the left side should have been the site of the greater number of pregnancies. However, he found about as many on the right side as on the left. Titus says " . . . purely mechanical interference has been shown . . . to be of doubtful etiologic importance." Less than 10 per cent of the specimens Litzenberg examined showed positive evidence of salpingitis when subjected to pathologic examination (1937). In a study of salpingitis as an etiologic factor in ectopic gestation Van Etten found that only 10.4 per cent of the cases observed in a large metropolitan hospital, "showed signs of previous or concurrent tubal inflammation." In MacFarlane and Sparling's series of 110 cases only 17.2 per cent gave a history of pelvic infection. Only eighteen of Tenney's 150 cases gave a past history of pelvic infection. He observes, " . . . but as that is a difficult history to obtain, I feel it fairer to rely on the pathological sections which show a much higher incidence."

Kerr is amazed not only by the absence of chronic salpingitis and appendicitis but by the absence of venereal disease. He admits, however, that a mild pelvic infection is probably the cause in the large majority of cases.

Another observation made by Tait which

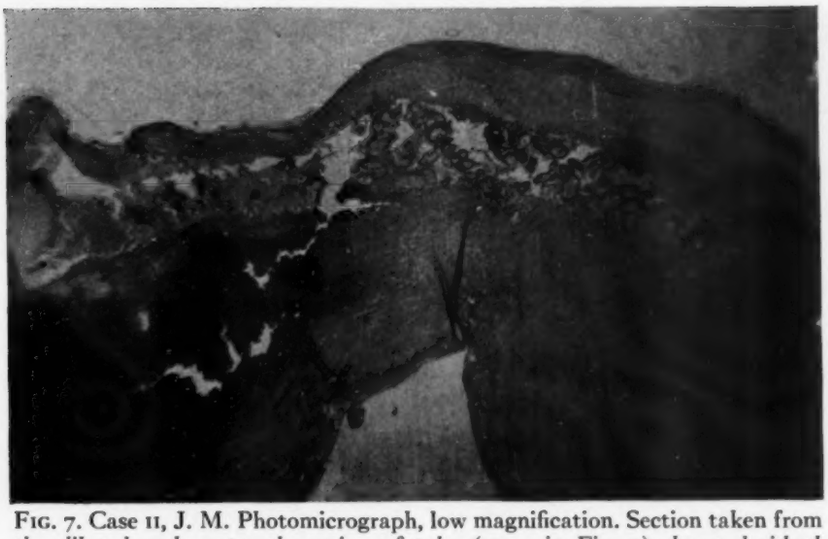

FIG. 7. Case 11, J. M. Photomicrograph, low magnification. Section taken from the dilated and ruptured portion of tube (see *c* in Fig. 2) shows decidual reaction and chorionic villi partly buried in the wall and partly free in the lumen of the tube.

has been confirmed by subsequent workers is the occurrence of ectopic gestation in women who have experienced a period of protracted sterility associated with a pelvic inflammation following an earlier pregnancy. Tait remarks, "that a very large proportion of them [ectopic victims] have a history of prolonged sterility and menstrual suffering, showing that their procreative machinery was out of gear. Thus we often have the history common to tubal mischief that after a first labour there was an illness with marked symptoms of pelvic trouble, then a long period of sterility, then the ectopic gestation ending in rupture."

Beckwith Whitehouse, who supports gonorrheal salpingitis as a cause of ectopic pregnancy, directs attention to the infrequency of this condition in nulliparae and to its frequency after a long period of sterility which has been preceded by an adnexal infection.

Kelly states that women who have had pelvic inflammatory disease followed by a period of sterility may develop an ectopic pregnancy. In the experience of Titus a period of sterility may follow an earlier pregnancy.

In thirty-six (20.8 per cent) of the patients in this series there was a period of relative sterility ranging from three to seventeen years.

In Weil's series 32 per cent had relative sterility of five years or longer. Sadler reports relative sterility ranging from six to seventeen years in 26.6 per cent of his cases. Lisa et al. state that 48.3 per cent of their multiparae had a period of sterility of three or more years;

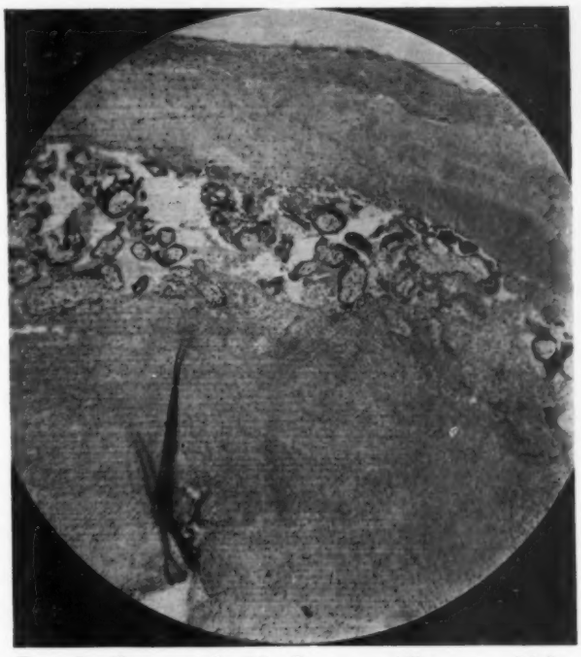

FIG. 8. Case 11, J. M. Same as Figure 7; higher magnification.

60 per cent of the multiparae in Brown's series experienced relative sterility of three or more years. Of the ten cases of secondary abdominal pregnancy reported by Reel and Lewis, nine patients were sterile from three to twelve years; the other patient was a nullipara.

On the other hand, Fitzgerald and Brewer found that "a long period of sterility is not the rule."

In evaluating relative sterility as an etiologic factor one should keep in mind the fact that

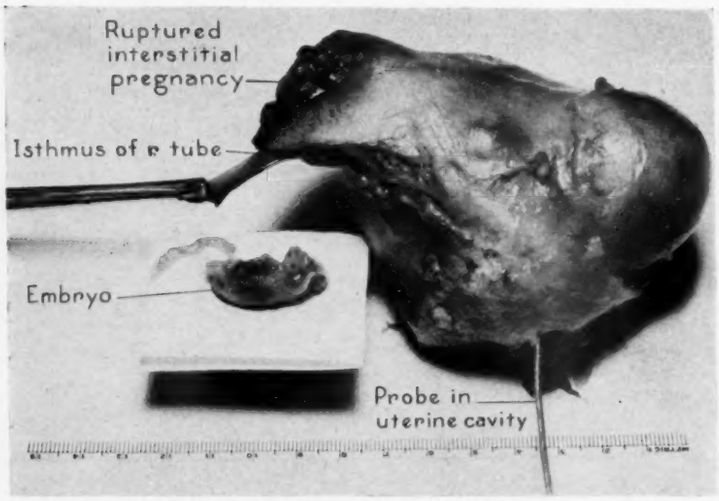


FIG. 9. Case III, E. C. Photograph of ruptured *interstitial* pregnancy of right fallopian tube. Supravaginally extirpated fibromyomatous uterus. Note clamp on proximal portion of the isthmus of right fallopian tube. Insert shows the embryo; menstrual age of fetus seventy-four days.

the physician seldom has absolutely reliable information about the use of contraceptives by all his patients and that temporary sterility frequently occurs in the male.

Herzog says that inflammatory diseases of the uterus and tubes should be disregarded as possible causative factors in ectopic gestation. He maintains that these conditions render a woman temporarily sterile for either normal or ectopic pregnancy.

Mall studied the fate of the ovum in 117 cases of tubal gestation. On the basis of this work he concluded that in the presence of acute or subacute tubal inflammation the ovum degenerates. When the tube is convalescing from high infection, it possesses certain anatomic characteristics, like saccules or multiple small lumina, which prevent the ovum from completing its transit to the uterus. In this convalescent state, however, the tube is sufficiently healthy to permit tubal implantation and this occurs. If the pregnancy had not occurred at this time, the tube probably would have continued to heal and in a few years would have been able to propel the ovum safely to the uterus.

The greater frequency of ectopic gestation in urban than in rural areas is further evidence that pelvic inflammatory disease is a cause of ectopic pregnancy. The higher incidence of gonorrhea in cities explains this. Mall and Stander remark specifically on the wider prevalence of gonorrhea in cities as a causative factor. My own experience confirms this view. The use of penicillin and sulfonamides should reduce the importance of gonorrheal salpingitis as a cause of ectopic gestation.

*Salpingitis.* The role of all varieties of salpingitis in ectopic gestation is the same—interference with the downward passage of the ovum. This interference is caused by many sequelae of the infection: saccules in which the ovum becomes entrapped; adhesions which cause tubal kinks; luminal stenosis or the development of several narrow lumina which preclude the free passage of the ovum. Salpingitis also destroys the cilia necessary for propelling the ovum and reduces the peristaltic action of the tube. Tuberculous salpingitis may seal the tube and exclude the ovum entirely.

*Adhesions.* These may be caused by conditions arising inside or outside the tubes. Prominent causes are acute and chronic appendicitis, pelvic and abdominal operations, peritonitis occurring after rupture of an intestinal or gastric ulcer, tuberculous peritonitis, gonorrhea, puerperal infection, septic abortion and perisalpingitis. In the experience of Kelly peritoneal adhesions are a frequent etiologic factor in tubal gestation because of their serious constriction and relative occlusion of the tubal lumen.

*Abdominal and Pelvic Operations.* These surgical procedures are followed by inflammation and adhesions which may interfere with

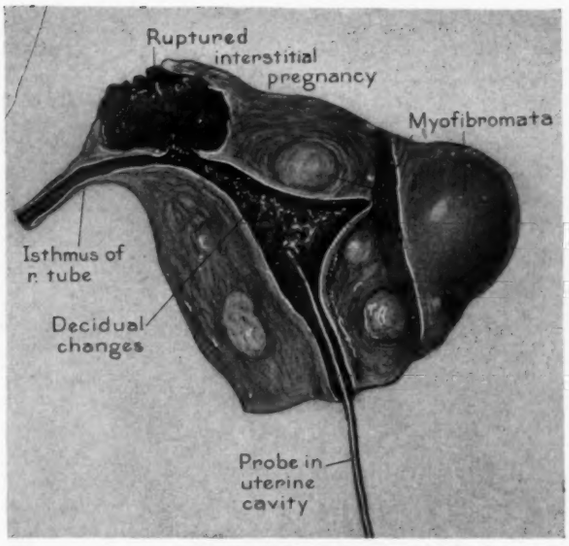


FIG. 10. Case III, E. C. Schematic drawing of section through extirpated uterus of Figure 9, showing rupture through the interstitial portion of right fallopian tube, distorted uterine cavity, hypertrophied endometrium and several fibroid nodules in myometrium.

FIG. 11. Case III, E. C. Photomicrograph through ruptured *interstitial* portion of right fallopian tube. Note chorionic villi burrowing into crater-like depression in the musculature; low magnification.

tubal peristalsis or result in tubal stenosis. In the present series thirty-four (19.7 per cent) of the 173 cases had had previous abdominal and pelvic operations as follows: appendectomy, cholecystectomy, myomectomy, suspension of uterus, cesarean section, previous ectopic pregnancy, partial salpingectomy and cauterization and conization of cervix.

Attempts to interrupt pregnancy by abortion may bring about tubal implantation. In fifty-five (31.8 per cent) of the patients in our series there was a definite history of previous abortion. Anspach points out that ectopic gestation increased greatly after the legalization of abortion in Russia. Schauffler and Wynia report that 34 per cent of the patients in their series had had abortions. Langman and Goldblatt's series of 310 cases reveal an unusually high incidence of previous lower abdominal operations.

*Neoplasms.* The growths may be within the tube or near it. Internal growths include tumors originating in the tubal mucosa or folds, polyps or pedunculated tumors such as chondroma (Outerbridge). External growths include parovarian cyst (Cullen and Brady), ovarian cysts, fibroids, adenomyoma of the uterine cornu and myomi uteri. Internal growths near the interstitial portion of the tube act as a mechanical barrier to the passage of the ovum. External growths which press upon the tube constrict its lumen. Even a bean-sized fibroid at the cornu (Figs. 9, 10, 11, 12 and 13, Case III) may narrow the lumen of the tube.

*Congenital Malformations.* These are probably the result of an anomaly in the embryonic development of the Müllerian ducts. In 1946 I discussed sequelae of maldevelopment of these ducts. Congenital malformations include trumpet-shaped tubes, accessory ostia, accessory tubes, unusually long and narrow tubes, diverticula, tortuosity of the tubes, and infantile tubal convolutions. Accessory ostia, accessory tubes and diverticula terminate as saccules in which the ovum becomes entrapped but they do not interfere with the peristaltic action of the tube. Tortuosity, convolutions, unusual length and narrowness of the tube interfere with the progress of the ovum. Infantile tubes show imperfect ciliary development.

*Abnormal Ovum.* The abnormality may take the form of an excessively large twin ovum which, because of its size, cannot complete the tubal passage even before development of its trophoblast.

*Tubal Atrophy.* This state may be caused by malnutrition or hormonal disturbance and

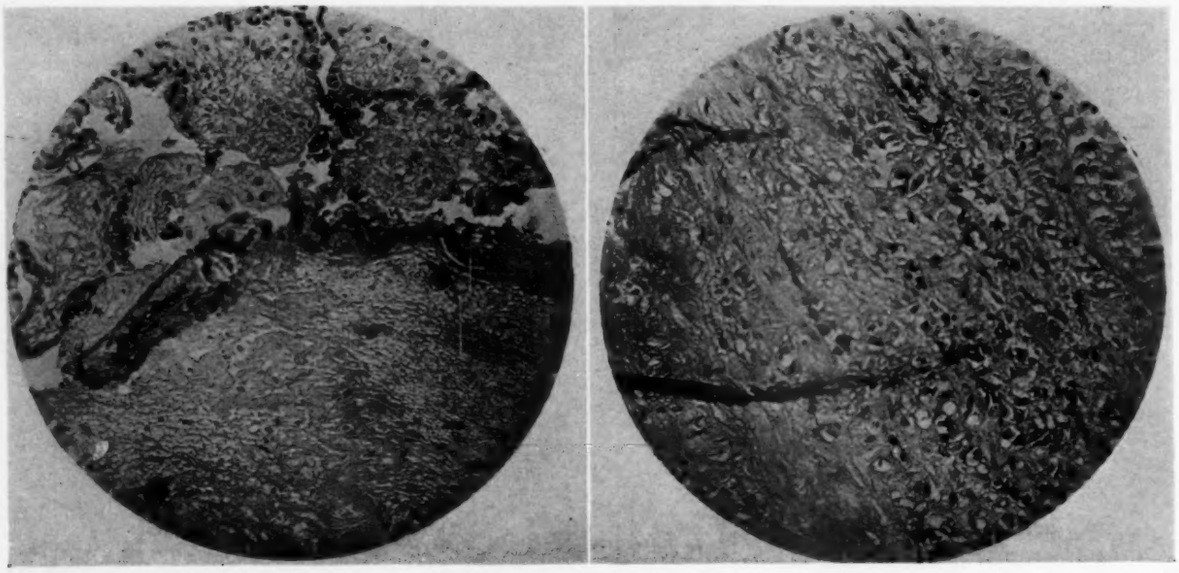

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FIG. 12. Case III, E. C. Same as Figure 11; high magnification.
FIG. 13. Case III, E. C. Ruptured interstitial pregnancy. Photomicrograph of a section from the cornu shows decidual reaction; high magnification.

may follow puerperal infection. It results in reduced peristalsis.

*External Migration of the Ovum.* Because of an atretic or occluded tube, the ovum may travel to the opposite side. Ectopic nidation is then produced because the egg has grown abnormally large and because its trophoblast has developed.

*Endometriosis, Decidual Response.* The importance of decidual response as an etiologic factor in tubal pregnancy remains uncertain. Together with endometriomatous patches, it has been conceded by some authors (Curtis, Kerr) to be a possible cause of ectopic gestation. At laparotomy nests of endometriosis are often encountered. On the other hand, in 310 cases Langman and Goldblatt found no substantial evidence to confirm endometriosis as an etiologic factor.

*Tubal Spasm.* By constricting the tubal lumen, the spasm retards the downward passage of the ovum. The spasm may be the result of nervous influences or the use of certain drugs.

*Metabolic Deficiency.* It is Allen's belief that the most frequent cause of ectopic nidation is a marked metabolic defect, probably of nutritional origin, which might affect not only the germ plasm itself but also the pelvic transportation system by changes in pelvic physiology.

*Intra-uterine Pessary.* According to Welton and Ellingson this contraceptive device is likely to give rise to chronic endometritis and to facilitate the establishment of infection which may result in salpingitis. Both conditions may cause ectopic pregnancy. In three years Potter encountered three cases of ruptured ectopic gestation in which the patient was wearing a pessary at the time of examination.

*Abdominal Pregnancy.* Most cases of abdominal pregnancy are secondary, the result of a rupture into the peritoneal cavity from the original site of nidation. However, there are cases of abdominal pregnancy on record which were undoubtedly primary.

In 1888 Lawson Tait said, "That a fertilised ovum may drop into the cavity of the peritoneum and become developed there, is a contingency I cannot accept for a moment, for the powers of digestion of the peritoneum are so extraordinary that an ovum, even if fertilised, could have no chance of development."

Curtis states that primary abdominal pregnancy may not be as rare as it was formerly thought to be. He surmised that the increased incidence of pelvic endometriosis has brought with it a corresponding increase in the incidence of primary pregnancy in the abdominal cavity.

Anspach says, "The frequency of endometriomatous patches on the peritoneal surface and the occurrence of decidual reactions (20 per cent of all pregnant women who came to

autopsy, observed by Curtis in Ghon's and Pick's laboratories) of the peritoneum suggest that occasionally such soil becomes available" for abdominal pregnancy.

Studdiford (1942) believes that a fertilized ovum which is not engulfed by the fimbriated end of the tube will embed in any tissue, regardless of character, which its blastocyst chances to reach. With the exception of the germinal epithelium of the ovary, such tissue must be either visceral or parietal peritoneum. If the ovum embeds in parietal or visceral peritoneum, the condition must be regarded as a primary peritoneal pregnancy.

*Ovarian Pregnancy.* Ovarian pregnancy may result from a primary or secondary implantation in or on the ovary. According to Wollner, this ectopic condition is based upon pathologic ovulation of the graafian follicles.

*Cervical Pregnancy.* In cervical pregnancy, an uncommon type of ectopic pregnancy, the fertilized ovum, instead of nidating in the upper corpus uteri, traverses the uterine cavity and enters the cervical canal. Before it reaches the external os, cervical implantation takes place. Studdiford (1945) suggests that cervical implantation may be the result of an unknown but most likely accidental influence. (Fig. 14.)

### SYMPTOMS AND PHYSICAL FINDINGS

For the sake of diagnostic convenience, ectopic gestation may be divided into two groups, typical and atypical cases.

*Typical Cases.* The typical case involves little diagnostic difficulty. This patient may or may not have missed a menstrual period. She suddenly experiences severe abdominal pain which may radiate to the shoulders. She may be nauseated and may vomit or faint. Usually, although not always, she has passed dark brown blood *per vaginam.* Her skin will be cold and clammy. She may be pale, cyanotic, restless, thirsty and may have air hunger. The pulse is rapid and small. Blood pressure and temperature usually will be subnormal. The leukocyte count usually will exceed 10,000. The red cell count and hemoglobin index may not have reached alarmingly low levels by the time the physician is first consulted.

Physical examination will reveal general abdominal tenderness most noticeable over the site of greatest pain and a very tender cervix, usually of bluish hue. In about half the cases no pelvic mass can be palpated. The patient is dangerously ill and is either in actual or impending shock. Obvious massive hemorrhage dictates surgical interference as soon as practicable.

*Atypical Cases.* Most of the diagnostic errors occur in atypical cases. The symptoms

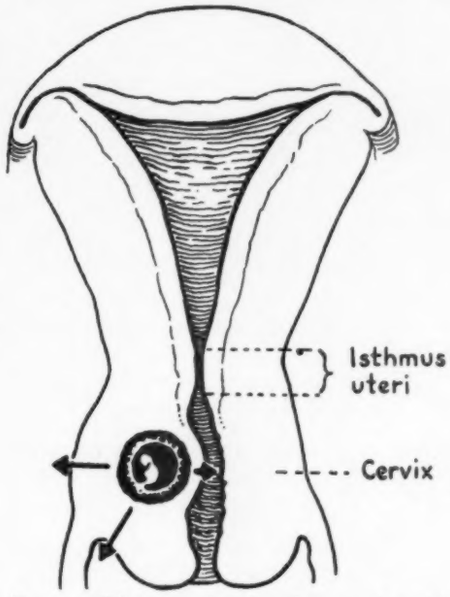


FIG. 14. Diagram showing four weeks' old ovum implanted in cervix. Further development leads to (1) expansion of cervical mucosa overlying nidation site in direction of cervical canal; or (2) rupture of infra- or supravaginal cervix if the cervical muscularis is deeply invaded by chorion. (From STUDDIFORD. *Am. J. Obst. & Gynec.*, 49: 169, 1945.)

may be so vague and confusing that correct preoperative diagnosis is impossible or can be established only after a period of observation, during which various diagnostic aids have to be used. If the atypical case is one of unruptured ectopic gestation, correct preoperative diagnosis will be a rare triumph.

In cases of intact ectopic gestation the history may contain revealing hints. There may be amenorrhea. Before rupture or abortion, hemorrhagic vaginal discharge seldom occurs. A history of pelvic or abdominal operations, pelvic inflammatory disease, low fertility or prolonged sterility will be of value. The blood picture is often non-contributory.

Physical examination may reveal a moderately soft cervix and a slightly enlarged uterus. Pelvic pain may be absent entirely or may be restricted to discomfort. However, pain on motion of the cervix is of significance. Although

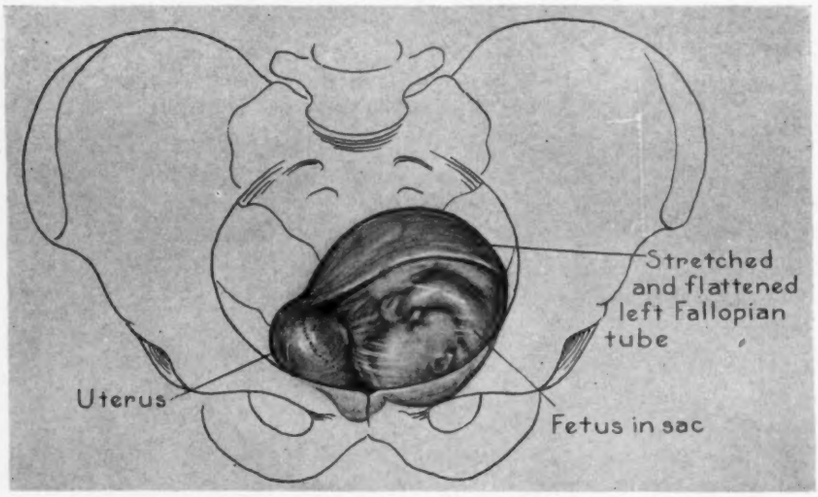


FIG. 15. Case IV, V. S. Schematic drawing of abdominal pregnancy. Uterus and cervix pushed to the right by the fetus in the sac. The sac fills most of the pelvic cavity and almost reaches the umbilicus. It covers the left side of the uterus anteriorly and posteriorly. The sac is formed by the left fallopian tube and ovary and left lateral wall of pelvis.

on first examination no masses may be felt, there may be tenderness and rigidity of the fornices; at a subsequent examination a pelvic mass may be discernible.

The complaint may be so mild that the patient does not consult her physician. Even the more pronounced signs of incipient rupture or abortion do not alarm some women and if such a patient does consult her physician, he may dismiss her for lack of significant symptoms. In time circulatory changes may separate the ovum from its blood supply and fetal death takes place with absorption of the embryo.

Women are notoriously indifferent to deviations from normal menstruation. It is safest for the physician to assume that any irregular hemorrhagic vaginal discharge is indicative of a disturbed pregnancy or of malignancy as these conditions may require immediate and strict supervision. He should make a prompt attempt to ascertain the true cause of the bleeding.

Tenney calls attention to the absence of spotting as a danger signal. He says, " . . . it stands out definitely that the acute type of cases and the more dangerous were those that did not show staining on admission."

In our hospital service we frequently encounter desperately ill patients brought in by ambulance from whom it is often impossible to obtain any information of diagnostic value. If they are able to give information, they often insist that they were perfectly well up to the onset of the acute symptoms. These patients are among the severe cases in whom we usually find massive hemorrhage (Figs. 9, 10, 11, 12 and 13.)

Tenney adds, "The absence of bleeding indicates a living pregnancy up to the time of rupture and therefore a more potentially dangerous source of disaster."

The other variety of atypical case follows one of three courses: (1) It presents the features of an incipient abortion or small rupture which disturbs or kills the ovum, resulting in a slow leakage of blood into the peritoneum. (2) The ovum may survive disturbance and be aborted into the peritoneal cavity where it may continue to develop as a secondary abdominal gestation and follow the characteristic course of that condition. (Figs. 15 and 16, Case IV.) (3) Blood may accumulate in the tube and form a hematosalpinx. (Figs. 17 and 18, Case V.) The tube may rupture at the infundibulum, the blood escaping into the peritoneal cavity and forming a hematocele. If tubal rupture occurs between the layers of the broad ligament, a hematoma results.

This atypical patient presents well defined symptoms of her condition. Careful evaluation of the history is important. It usually will include dull, unilateral, colicky pain and perhaps amenorrhea. Coincident with or close to the onset of pain brownish vaginal bleeding or spotting appears. Decidual shreds may have been passed.

Physical examination reveals abdominal

tenderness over the site of pain. A unilateral pelvic mass is often present and a hematocele may be palpable. The cervix is soft and tender; the uterus is slightly enlarged. The pulse, temperature and leukocyte count are usually somewhat elevated.

This patient is not in immediate peril. The surgeon may make an immediate diagnosis of ectopic gestation but he should not be considered remiss if he insists on employing diagnostic aids to help him differentiate the ectopic gestation from several other pathologic entities which closely simulate it.

The symptoms which may lead to a diagnosis of ectopic gestation can be so confusing that the physician may well consider the possibility of this condition in any woman of child-bearing age who complains of unilateral lower abdominal pain and menstrual irregularity of recent origin. The clinical picture may be clouded by the appearance, order and severity of the symptoms and by concomitant pathologic findings.

The signs most often encountered are amenorrhea, abdominal pain, vaginal staining or bleeding, abdominal and pelvic tenderness and masses.

*Amenorrbea.* This symptom is not nearly as uniform as abdominal pain. In the present series 126 patients (73 per cent) of the 173 cases studied had amenorrhea and forty-seven (27 per cent) did not.

Atlee reports that approximately one-half of his patients with ectopic pregnancy presented this symptom. Kerr found that in many of his patients one period was usually missed before the onset of pain and hemorrhage. Burch and Seitchik report that 90 per cent of the patients they studied had missed a period. Ware and Winn (1941) found that 50.66 per cent of their patients experienced no amenorrhea; 28 per cent had missed one menstrual period; 16.66 per cent had missed two menstrual periods and 2 per cent had missed more than two periods. Torpin (1945) reports that 75 per cent of his patients complained of amenorrhea.

Patients sometimes experience amenorrhea but fail to report it because they confuse vaginal spotting or bleeding with a menstrual period. It requires meticulous questioning by the examiner to elicit the facts and the patient's condition may not permit this. Disturbance or death of the ovum with subsequent uterine hemorrhage frequently takes place before or near the next period so that the patient regards the vaginal discharge as a regular menstruation.

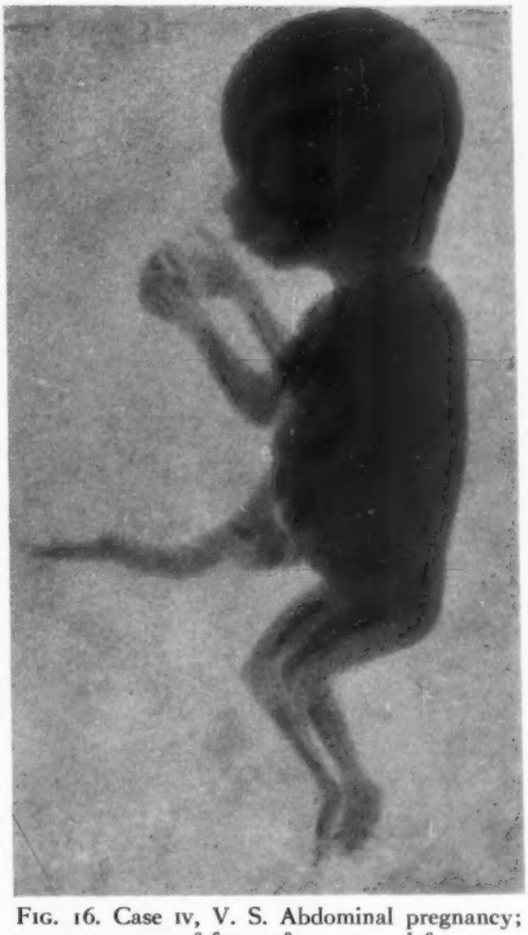

FIG. 16. Case IV, V. S. Abdominal pregnancy; roentgenogram of fetus after removal from sac. This fetus was a male, 9 cm. in length. It moved feebly for a few minutes after birth; fingernails were present. Roentgenogram reveals centers of ossification in diaphyses of all long bones of hands and feet.

*Pain.* This is the commonest symptom reported. In our series abdominal pain was present in 153 patients (88.4 per cent). In thirty-seven patients it occurred mainly in the right lower quadrant; in thirty-six in the left lower quadrant and in eighty patients it was generalized.

In a study of 410 ectopic gestations Lavell found pain in every patient from whom a complete or reliable history was obtained. Fitzgerald and Brewer report that some type of pain was the most common symptom in their 500 cases. Two-thirds of their patients complained of sudden, severe pain. Marchetti et al. found pain in 98.5 per cent of their patients. In Atlee's study some degree of pain

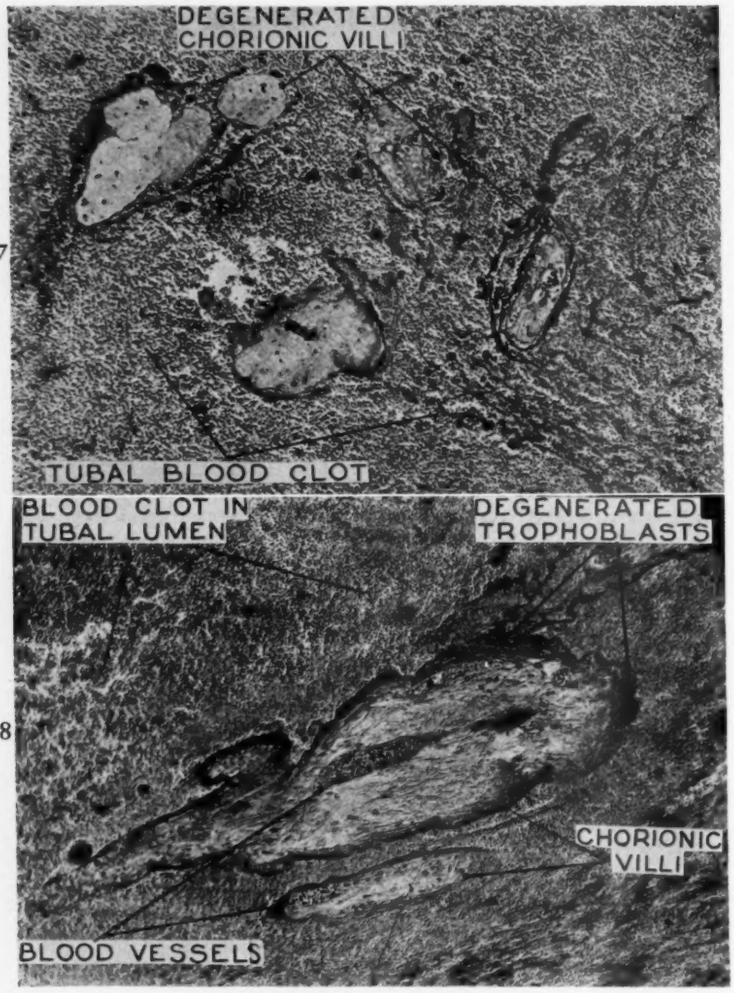


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FIG. 17. Case v, O. G. Preoperative diagnosis was left ovarian cyst. Postoperative diagnosis was hematocele. After making many microscopic sections in the wall of the tube, no chorionic villi were found. After making many sections through the blood clot, several necrotic chorionic villi were found in the midst of the blood clot.

FIG. 18. Case v, O. G. Preoperative diagnosis was left ovarian cyst; postoperative diagnosis was hematocele. After making many microscopic sections in the wall of the tube, no chorionic villi were found. Two vascularized chorionic villi were found in the midst of the blood clot. The villi and the remnants of the living trophoblastic cells are completely necrotic.

was reported by every patient. Kerr states that pain is almost universally present.

The onset of pain generally occurs after exertion, coitus or defecation. Its character varies according to the status of the pregnancy. The pain immediately preceding, accompanying and following ectopic rupture or abortion is severe, knife-like and lancinating. In some cases its onset is preceded by several days of indefinite cramps. It may be continuous or intermittent. At first it is usually unilateral, restricted to the site of the pregnancy. Later it may become generalized over the entire abdomen and spread to other parts of the body. Extension of pain to the shoulder is a common symptom. Other sites to which pain may be referred are the rectum, umbilicus, bladder, legs and gallbladder area.

The severe pain characteristic of ectopic gestation is caused by (1) distention of the tube and tearing of the tubal structures during rupture or abortion; (2) irritation caused by blood in the peritoneal cavity; (3) subdiaphragmatic accumulation of blood irritating the phrenic nerve, thus resulting in acute shoulder pain.

According to Falls (1941) the pain of unruptured ectopic gestation is rarely severe; it is usually unilateral and colicky. This pain is the result of (1) erosion by the chorionic villi and (2) tubal distention. While it is usually sufficiently severe to cause the patient to seek medical aid, it may be limited to minor discomfort.

*Vaginal Staining or Bleeding.* This is a frequent symptom. In my series vaginal bleeding or spotting was a symptom in 126 cases (73 per cent). Farell and Scheffey report that the majority of their cases of ruptured tubal pregnancy were characterized by bleeding before the expected time of menstruation. The majority of Fitzgerald and Brewer's patients complained of "abnormal bleeding." In their series of 115 cases Lisa et al. found that ninety-seven had experienced some bleeding. Ware and Winn (1946) say that in three out of every four cases of ectopic gestation some kind of hemorrhagic vaginal discharge is present.

As long as the ovum remains intact and continues to develop, uterine bleeding is usually absent (Schumann). The hemorrhagic vaginal discharge is caused by shedding of the degenerated uterine decidua after disturbance or destruction of the ovum. At times the entire decidua is expelled as a cast and both the physician and patient mistake it for an early aborted intra-uterine pregnancy. Unless a thorough microscopic examination is done and trophoblasts are found, it is impossible to make a proper diagnosis.

Vaginal bleeding may be limited to dark brown, scanty spotting, intermittent or continuous; or it may be sufficiently profuse to suggest intra-uterine abortion, especially if accompanied by decidual shreds. Profuse vaginal bleeding is more apt to be caused by intra-uterine than by extra-uterine gestation. The vaginal bleeding is never proportionate to the internal loss of blood. Because the onset of the staining or bleeding is sometimes coincident with an expected menstruation, the patient may incorrectly believe that a regular menstruation is in progress.

Vaginal bleeding may be the first symptom noted. It may be coincidental with the onset of pelvic pain or it may follow pain. Farell and Scheffey found that the majority of patients with tubal rupture reported vaginal bleeding before the expected menstrual period. At vaginal examination the physician may detect hemorrhagic discharge of which the patient was unaware.

*Nausea and Vomiting.* Although these symptoms are common characteristics of advanced abdominal pregnancy, they do not appear with marked frequency in the types of ectopic gestation which terminate early. When they appear as early symptoms, they are the result of peritoneal irritation, intramural hemorrhages which cause distention of the tubal wall and tubal colic.

In this series nausea and vomiting occurred in fifty-six cases (32 per cent). In Meagher's 247 cases of ruptured ectopic gestation, 147 patients complained of "vomiting of rupture." Langman and Goldblatt found that nausea was the most frequent general symptom with 162 patients reporting it; in the same series 140 patients complained of vomiting. Nucci reports that twenty-two of his 150 cases complained of nausea and vomiting. Lisa et al. noted vomiting in thirty and nausea in nineteen of their 115 patients.

*Faintness and Weakness.* These appear with varying degrees of frequency and are the result of rupture or abortion. They are likely to appear more often when the initial bleeding is massive or in the patient who ignores the early signs of her condition and in whom bleeding becomes extensive.

In my series of 173 cases faintness and weakness occurred in 81 patients (47 per cent). This included sixteen who were in shock. In the series reported by Marchetti et al. 29.1 per cent experienced these symptoms. In Langman and Goldblatt's series of 310 cases, 133 patients complained of weakness and ninety-one fainted. Actual syncope occurred in 64.8 per cent and faintness in 18.8 per cent of Falk and Rosenbloom's patients.

According to Moon shock is caused by "*a disparity between the volume of blood and the volume-capacity of the vascular system.*" Although this symptom is not reported with uniformity, hemorrhagic shock is present in some degree in all cases of tubal rupture or abortion (Woodhouse). The reduction in the volume of blood is manifested by falling blood pressure and temperature, a rapid, feeble pulse, rapid respiration, pallor with clammy skin, faintness and syncope.

Shock was present in sixteen (9.2 per cent) of the patients reported in this series. Various

authors report the percentage of patients admitted in shock as follows: Marchetti et al., about 10 per cent; Leff and Winson, 26.1 per cent; Sadler, 27.4 per cent. Fitzgerald and Brewer report severe collapse in 18.2 per cent of their cases. In the series reported by MacFarlane and Sparling forty-one patients (37.3 per cent) experienced preoperative shock.

DeLee and Greenhill (1943) consider tubal distention to be a cause of shock. They state that severe prostration without enough blood loss to explain it has been observed. Trauma is undoubtedly the cause of such preoperative collapse.

*Urinary Disturbances.* These results of peritoneal irritation set up by hemorrhage into the cul-de-sac are sometimes reported. Bladder irritation with frequent micturition may appear as an early symptom. Dysuria may appear in a mild degree after intraperitoneal hemorrhage.

In this series there were definite urinary symptoms in eleven cases (6.35 per cent). Undoubtedly this condition was present in a greater number of patients but for various reasons the facts were difficult to determine.

Of Meagher's 247 cases of ruptured ectopic gestation, seventy-six suffered from urinary symptoms. Anuria is occasionally encountered.

*Infrequent Symptoms.* Several symptoms are observed with minor frequency. In unruptured tubal, ovarian or abdominal pregnancy the classical signs of normal gestation may be constant indicators of the condition, but in the other types of ectopic gestation they are not sufficiently dependable to be of appreciable diagnostic value (Siegler). Breast changes, for example, are reported infrequently in ectopic gestations that terminate at an early date but they may well be expected in long-term abdominal pregnancy. In his series of 474 cases Urdan observed colostrum in the breasts of only twelve patients. Intraperitoneal hemorrhage, by its irritative effects, may cause constipation alone or constipation alternating with diarrhea. Reel and Lewis believe that in abdominal pregnancy the significant symptom of lower abdominal pain associated with growing constipation is the result of the intra-abdominal locus of the placenta and the inclination of this organ to adhere to the sigmoid. Rectal tenesmus, caused by feces pressing upon the blood deposited in the cul-de-sac, is sometimes reported. It was a complaint presented by eight of my patients.

The patient may show signs of early pregnancy, such as Chadwick's (Jacquemier's) sign.

Abdominal and pelvic examination may be unnecessary because of the presence of objective symptoms confirmatory of a preoperative diagnosis of ectopic gestation. Such examinations may be impossible because the serious condition of the patient precludes them and makes immediate surgical intervention imperative. In carrying out the physical examinations, the physician should exercise the utmost care lest he cause rupture of an intact pregnancy or further hemorrhage of an already ruptured sac.

Abdominal examination reveals varying degrees of tenderness which usually is most noticeable in the area of severest pain.

In my series tenderness and rigidity were observed in eighty-three cases (48 per cent). In twenty-five patients (14 per cent) these signs were noted mainly in the right lower quadrant; in fifteen (9 per cent) in the left lower quadrant; in forty-three (25 per cent) they were generalized; and in seven (4 per cent) they were not observed.

Lisa et al. found that tenderness was the most frequent sign; it was detected in eighty-eight of their 115 patients. Atlee found some degree of abdominal tenderness in all his patients.

The tenderness may be generalized but more often it is confined to one or both lower quadrants. In some cases the abdominal tenderness is out of proportion to the pelvic findings. Rebound pain and abdominal distention are sometimes observed. Resistance often extends over the entire abdomen and is apt to be maximal at the site of greatest tenderness. The rectus muscles may be rigid.

*Abdominal Masses.* These were observed in thirteen patients (7.5 per cent) in this series. In seven patients they were detected in the right lower quadrant, in four in the left lower quadrant and in two instances they were found in the hypogastrium. Many of the remaining patients in the series may have had abdominal masses but because of rigidity and severe pain, it was impossible to discover them.

Cullen's sign, a bluish discoloration at the umbilicus, is a valuable indication of intraperitoneal hemorrhage. This sign, however, is rare. It is discernible most often in patients with umbilical hernia.

Abdominal examination may suggest any of

several pelvic pathologic conditions, namely, ectopic gestation, appendicitis, acute salpingitis, pelvic exudate, intestinal obstruction or ovarian cyst.

An infrequent but important abdominal finding is fluid wave which is present in cases of intraperitoneal hemorrhage. (See Case III.) This symptom was elicited in only four of my cases. Patients who may show a fluid wave are usually so desperately ill that they cannot be subjected to manipulation to elicit this sign. Torpin (1944), who noted it in nineteen women, emphasizes its value in the presence of "an abdominal crisis." Meagher reports this symptom in forty of his 247 cases of ruptured ectopic gestation.

Pelvic examination reveals a variety of signs which are the result of the age of the pregnancy and the extent of internal hemorrhage. There is general agreement among physicians on the excessive tenderness encountered when pressure is exerted on the affected side. Unilateral pelvic mass and cervical tenderness are the most significant findings. Careful recto-vaginal examination should be made to establish the connection of the extra-uterine mass with the uterus.

In the first weeks the cervix and uterus show no changes. As the pregnancy grows, however, the cervix softens and assumes a bluish hue. Often the cervix is so tender that manipulation of it causes severe pain and prevents extensive pelvic examination.

Tenderness on motion of the cervix was pronounced in fifty-one (29.5 per cent) of the patients in my series. Extreme cervical sensitivity is the result of changes caused by pregnancy and peritoneal irritation caused by blood in the cul-de-sac which affects the utero-sacral ligaments, producing tenderness on motion (Johnson). The uterus softens and may enlarge. Typical uterine contractions or, rarely, contractions of the pelvic mass itself may be observed (Kelly). Formation of a hematocele results in uterine displacement. In the presence of free blood the cul-de-sac appears to be distended. If the blood has clotted, a definite mass can be palpated.

In thirty-six of the patients studied in this series the uterus was distinctly palpable; in twenty-three patients it was enlarged; in four retroflexed; in five soft; in three tender; and in one patient malformed. In other cases the uterus could not be mapped out because of pain or the extreme obesity of the patient.

Johnson frequently observed unilateral pulsation of the uterine artery.

Burch suggests that in making the pelvic examination the index finger should be inserted into the vagina, the ring finger into the rectum and palpation from the abdominal side should be made between the vaginal and rectal fingers.

*Pelvic Mass.* This will be palpated if the pregnancy is large enough or if clots have been formed by free blood. While a palpable pelvic mass is often reported, its absence should not rule out ectopic gestation. The pelvic mass may be in the adnexal region, in the cul-de-sac or in both places.

Pelvic masses were palpable in eighty-nine patients (51.4 per cent) in my series. In thirty-four patients the mass was detected in the right fornix, in twenty-eight in the left fornix and in twenty-seven in the posterior cul-de-sac. Tenderness of lateral fornices and posterior cul-de-sac was often elicited even though no masses were found. In some of these cases where operation was postponed for clarification of diagnosis masses were discovered on subsequent examination.

Lisa et al. found an adnexal mass in sixty-four of their 115 patients, a mass in the cul-de-sac in thirteen and a combined cul-de-sac and adnexal mass in eleven. Torpin (1945) considers pelvic mass a cardinal sign of ectopic gestation; he was able to detect pelvic masses in 94 per cent of his cases. Leff and Winson noted a palpable mass in 116 (62.6 per cent) of their patients. In cases where no mass can be palpated these authors call attention to the importance of marked tenderness elicited when the broad ligament on the affected side is put on tension.

Schauffler and Wynia found a lower abdominal mass in 44 per cent of their cases. Marchetti et al. palpated a pelvic mass in 70.2 per cent of their patients. Pelvic examination was not considered necessary in fourteen cases and in 19.1 per cent of their series no mass was found.

The pelvic mass varies in size, consistency and position. The age of the pregnancy and the extent of intramural hemorrhage determine its size. As time goes on the tube becomes adherent to the ovary, broad ligament or intestines; this results in the formation of a mass which usually is very sensitive. The mass may be soft and elastic; if there has been mural

hemorrhage in the tube, the swelling will be firm. The pregnant tube in its early weeks usually presents a unilateral swelling behind the uterus. As it grows it extends backward and downward, pushing the uterus forward and upward. The mass is rarely located in front of the uterus (Kerr). Before rupture the mass is egg-shaped or cylindrical; after rupture it assumes an irregular contour. A fluid or coagulated mass of blood in the cul-de-sac is evidence of repeated minor hemorrhages. Massive hemorrhage usually requires surgical intervention before blood clots can form. The pelvic masses palpated by Schauffler and Wynia varied from 5 to approximately 15 cm. in diameter.

*Decidual Cast.* This is of great diagnostic value but it should not be awaited as a confirmatory symptom in ectopic gestation because, first, it is a relatively late sign following severe pain with tubal abortion or rupture and, second, because it is not very often seen. Its passage may be unnoticed by the patient. Accompanied by hemorrhagic discharge of uterine origin, it indicates disturbance or death of the ovum. Of the 173 cases studied in my series, sixteen passed decidual casts which showed decidual reaction microscopically but no chorionic villi. One patient passed a cast that showed neither decidual reaction nor chorionic villi. Kerr and Mahfouz noted this symptom in 25 per cent of their patients.

*Temperature.* Writers are not entirely in agreement on the temperature in ectopic gestation but in general it may be said that in typical cases it is usually normal or subnormal and in atypical cases, normal or above normal. A subnormal temperature is one of the signs of massive intraperitoneal hemorrhage. The increased temperature reflects peritoneal irritation by free blood and the existence of mild pelvic peritonitis.

In our series of cases the temperatures were not high unless pelvic infection was present. They were subnormal in patients with abdominal hemorrhage. The highest temperature was 101.6°F. and the lowest was 95°F. Other readings were as follows: In sixty-two patients (36 per cent) temperatures were 100°F. or above; in ninety patients (52 per cent) temperatures were 98.6°F. to 100°F.; in twenty-one patients (12 per cent) temperatures were below 98.6°F.

In the experience of Fitzgerald and Brewer 84.8 per cent of patients with ectopic pregnancy had temperatures of 100°F. or below. Ware and Winn (1941) report that the temperature usually shows slight elevation. Atlee believes that "a subnormal temperature is a useful confirmatory sign in a woman with severe low abdominal pain and signs of internal haemorrhage, since acute ectopic is the only critical low abdominal condition likely to be associated with a subnormal temperature."

*Pulse Rate.* A pulse, increasing in rate and decreasing in volume, usually accompanied by a low hemoglobin index, may be expected in the presence of intraperitoneal hemorrhage. In my series of cases the highest pulse rate was 140; the lowest was 68. In an analysis of the cases the following rates were observed: In seventy-nine patients (46 per cent) the rate ranged from 68 to 90; in thirty-seven patients (21 per cent) the rate ranged from 91 to 100; in fifty-five patients (32 per cent) the rate ranged from 101 to 140; in two patients (1 per cent) the rate was imperceptible.

Ware and Winn (1946) consider a rapid pulse one of the most characteristic symptoms of ruptured ectopic gestation. These authors regard the rate and volume of pulse as more reliable indices of the condition of the patient who has recovered from the initial shock than the blood pressure readings. One hundred eleven (74 per cent) of Nucci's patients had pulse rates below 100. The remaining thirty-nine, cases of tubal rupture or tubal abortion, had pulse rates between 100 and 130 beats per minute. In cases of massive hemorrhage a rapid or thready pulse is frequently observed as part of the clinical picture and it generally is admitted that a persistent or increasingly rapid pulse rate is an important finding.

*Blood Pressure.* As one might expect, blood pressure drops when tubal rupture or abortion occurs. The decreasing blood pressure favors hemostasis (Titus). Should the blood pressure rise, hemorrhage is apt to be renewed (Welton, 1924).

Blood pressure readings were available in 147 cases (85 per cent) in this series. They are shown in Table IV.

Blood pressure was not recorded in twenty-six (15 per cent) of our patients. It will be noted that the high systolic pressure of 220 mm. had a corresponding diastolic pressure of 135 mm.; the systolic pressure of 170 mm. had a corresponding diastolic reading of

120 mm. In the systolic pressure of 40 mm. no diastolic pressure could be obtained. This patient, however, recovered. Low blood pressure readings were marked in cases of massive intra-abdominal bleeding.

Nucci found systolic readings below 100 mm. in one-third of his cases of tubal rupture while among twenty-five unruptured tubal pregnancies only three had systolic readings below 100 mm. In Schumann's experience the systolic blood pressure in cases of tubal rupture or abortion vacillates between 90 and 110 mm. with a constant pulse tension. Ware and Winn (1946) report, "The blood pressure is usually normal in the patients with a pelvic mass and below 100 systolic most frequently in the acutely ruptured cases."

TABLE IV

| Systolic | No. of Cases | Diastolic | No. of Cases |
|---|---|---|---|
| 60– 70 mm. | 9 | 20–50 mm. | 22 |
| 71– 90 mm. | 20 | 51–70 mm. | 71 |
| 91–120 mm. | 83 | 71–90 mm. | 51 |
| 121–138 mm. | 32 | | |
| 220 mm. | 1 | 135 mm. | 1 |
| 170 mm. | 1 | 120 mm. | 1 |
| 40 mm. | 1 | 0 mm. | 1 |

*Leukocyte Count.* Ectopic rupture or abortion produces leukocytosis which may be very high. It is the result of peritoneal irritation caused by the free blood. The leukocyte count drops precipitously when the hemorrhage stops but rises if it is resumed.

In our series of 173 cases the leukocyte count was reviewed in 157 patients (91 per cent) and is shown in Table v.

TABLE V

| | No. of Cases | Per Cent |
|---|---|---|
| 5,000–10,000 | 79 | 50 |
| 10,001–15,000 | 48 | 31 |
| 15,001–20,000 | 20 | 13 |
| 20,001–25,000 | 7 | 4 |
| 25,001–30,000 | 3 | 2 |

In the seventy-nine patients in whom the leukocyte count ranged from 5,000 to 10,000 laparotomy revealed an unruptured ectopic or slow leakage from a tubal pregnancy or old blood clots in the abdominal cavity indicating an old rupture. When symptoms indicated that rupture was recent and not massive, the leukocyte count was about 15,000. When the bleeding was recent or massive, the leukocyte count ranged from 15,000 to 30,000.

The count varies with the extent of intraperitoneal hemorrhage and the rate of blood absorption. As the hemorrhage ceases and the intraperitoneal blood is absorbed or sealed off, the leukocyte count decreases rapidly. In 85 per cent of Atlee's cases the leukocyte count was above 10,000, the figure considered to be an upper normal limit (Farrar).

The red blood cell count, like other laboratory data, should be evaluated in the light of the clinical picture as a whole. There is usually a significant degree of correlation between the red blood cell count and the hemoglobin index. In the presence of intraperitoneal hemorrhage, repeated analysis almost always reveals a falling red blood cell count and hemoglobin index. However, these blood studies do not necessarily indicate the amount of blood loss.

In this series a red blood cell count was recorded in 159 cases (92 per cent). The highest count was 6,500,000; the lowest 1,170,000. In an analysis of cases the following counts were observed:

| Count | Cases | |
|---|---|---|
| | No. | Per Cent |
| One million and over | 5 | 3.10 |
| Two million and over | 41 | 25.78 |
| Three million and over | 81 | 51.00 |
| Four million and over | 31 | 19.49 |
| Over six million | 1 | .63 |

Hemoglobin index signifies the withdrawal of blood from the general circulation. Ware and Winn (1941) state that rapid decreases in the hemoglobin index and red blood cell count and a concomitant increase in leukocytes point to internal hemorrhage. These authors believe that a rapid decrease in hemoglobin is a more valuable symptom than the initial reading. They frequently noted a decrease in hemoglobin and red blood cell count, associated with recurring pelvic pain and temporary leukocytosis. The hemoglobin index, like the red

blood cell count, does not reflect the true status of blood depletion until the passage of twenty-four to forty-eight hours.

Anemia depends upon the extent of blood loss. According to Kelly, anemia resulting from successive hemorrhages may be so severe as to cause death. An incomplete tubal abortion tends to bleed repeatedly (Titus). Torpin (1944) says that unsuspected anemia is very suggestive of ectopic gestation.

The sedimentation rate may be increased by massive hemorrhage even though infection is absent. The rate is seldom high unless infection sets in. However, if the rate is taken when hemorrhage starts and the hemorrhage is massive, the rate may be high. The pregnancy alone may increase the sedimentation rate.

Sedimentation values were noted in ninety-two cases (53 per cent) in this series. In thirty-two of these patients the values were normal. The rates were as follows:

| Rates | Cases | |
|---|---|---|
| | No. | Per Cent |
| 5–10 mm. | 32 | 35 |
| 11–15 mm. | 16 | 17 |
| 16–20 mm. | 13 | 14 |
| 21–25 mm. | 13 | 14 |
| 26–30 mm. and above | 18 | 20 |

In the experience of Nucci the rates were most rapid in cases of tubal abortion and tubal rupture and especially in those patients in whom there were concomitant low hemoglobin readings and pelvic inflammatory disease. This author noted a high correlation between the increased sedimentation rate and the extent of the peritoneal hemorrhage.

### SYMPTOMS AND PHYSICAL FINDINGS

#### ABDOMINAL PREGNANCY

Most abdominal gestations are secondary implantations usually resulting from tubal rupture or abortion. This condition presents many of the early symptoms of the other types of ectopic gestation. In the early weeks there may be amenorrhea, nausea, vomiting, signs of internal hemorrhage, weakness, fainting, syncope and a hemorrhagic vaginal discharge with or without passage of a decidual cast, indicating rupture or abortion. The symptoms may be sufficiently grave to cause the patient to seek medical advice and to receive surgical relief. If she survives the early symptoms without medical assistance, the fetus may die and its remains be absorbed or they may form a pelvic hematocele.

Occasionally the fetus survives rupture or abortion and continues to develop in the abdominal cavity where its placenta attaches itself to whatever pelvic organs it contacts. With the passage of time, the characteristic symptoms of the abdominal environment manifest themselves. (See Case IV.) The patient continues to experience the usual signs of pronounced peritoneal irritation, namely, nausea, vomiting, constipation or diarrhea and difficult and frequent micturition. Nausea and vomiting may continue through the last months. Cornell and Lash (1934) say, "Vomiting of blood and the passage of blood per rectum are seen occasionally. This seems to occur when the placenta is attached to the intestines." Cornell believes these symptoms are caused by chorionic villi eroding into the intestinal wall.

After the fifth month the abdomen becomes very sensitive. Fetal movements cause great pain by irritating the visceral and parietal peritoneum. The pain is more severe if the placenta is attached to a vital organ than if it is attached to the uterus or its appendages (Cornell and Lash). The pain may be so intense that it confines the patient to bed much of the time of the pregnancy.

If the fetus dies, maceration takes place with low grade infection, fever and pronounced toxemia. The patient experiences weakness, increased constipation and malaise. Hemorrhagic vaginal discharge of uterine origin may appear. These symptoms subsequently disappear as the fetus undergoes calcification.

If term is reached, spurious labor sets in. This may be characterized by increased fetal movement; painful uterine contraction may ensue and vaginal bleeding with expulsion of blood clots and decidua may take place.

Physical examination reveals an empty although somewhat enlarged softened uterus alongside the fetal mass. For the first two months the uterus enlarges as in normal pregnancy. In advanced abdominal gestation it may reach the size of a four months' preg-

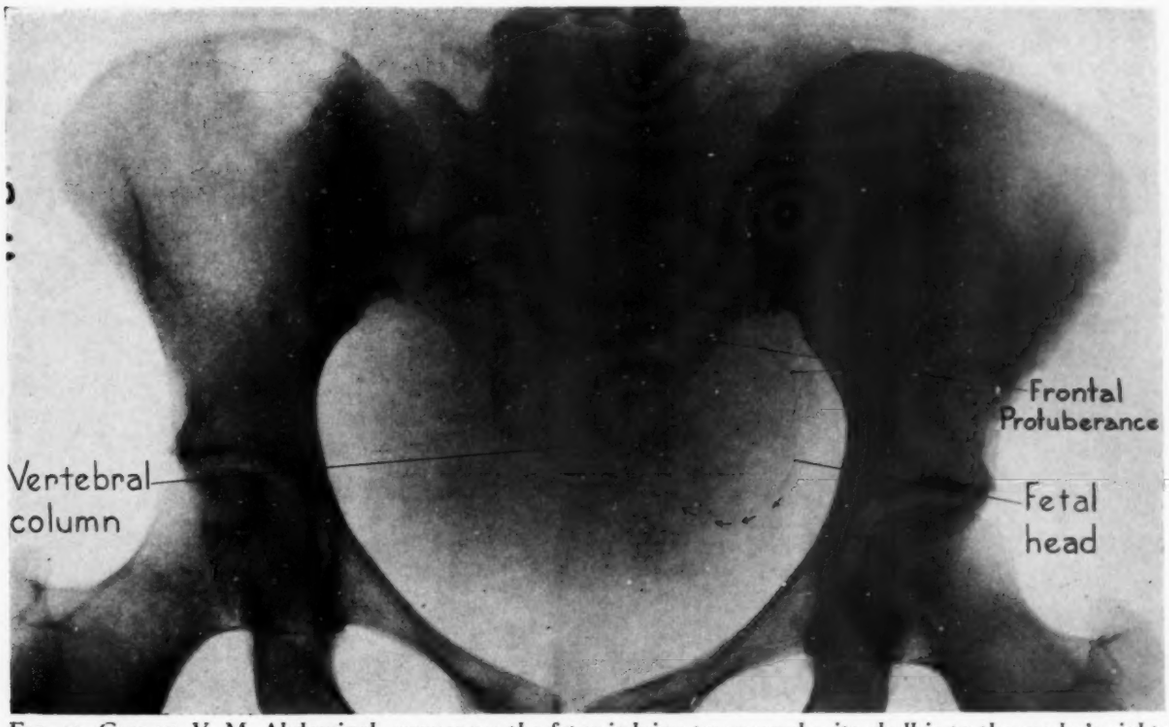


FIG. 19. Case VI, V. M. Abdominal pregnancy; the fetus is lying transversely; its skull is to the reader's right; vertebral column downward and ribs upward. The frontal region of skull is protuberant.

nancy; this occurred in some of my patients. The transverse position of the fetus (Figs. 19 to 22, Case VI), its unusually noticeable and painful movements and its abnormally loud heart tones are very pronounced. On bimanual rectovaginal examination the fetus and its movements can be palpated readily. In almost every one of Swanson's cases the fetus was found on the right side. Because of the absence of uterine musculature (Beacham and Beacham), the fetus appears to lie close to the surface of the skin. It can be moved readily and can be shifted from one abdominal quadrant to the other. The fetal parts can be palpated easily through the vagina. Braxton Hicks contractions are absent. The vagina is enlarged and soft. Although the cervix may be somewhat soft, it is usually firm and may be slightly dilated. Movement of it causes pain. Cervical displacement is governed chiefly by the position of the fetus. (Figs. 23 to 26, Case VII.) In his discussion of Schauffler and Wynia's paper on ectopic pregnancy, Casler called attention to an important observation made by Howard Kelly: "The cervix in abdominal pregnancy corresponds in size and consistency to the pregnancy above it, and not to the size of the uterus itself." The cervix may be abnormally high or it may extend low into the vagina.

According to Kelly the placental souffle is occasionally audible. Unlike the condition which prevails in normal intra-uterine pregnancy, in ectopic gestation this sound is a valuable aid in locating the placenta (DeLee and Greenhill, 1943).

Hegar's sign and ballottement, characteristic in normal pregnancy, are absent.

Gardner and Middlebrook observed that abdominal pregnancy seldom is complicated by other diseases or tumors, including the toxemias of pregnancy.

One of my patients developed hypertension during the latter months of pregnancy. This woman also had a fibromyoma of the uterus. (Case IX.)

Harrar gave three points which are valuable in establishing a diagnosis of abdominal pregnancy:

"1. History in the early months of supposed miscarriage, with possible passing of shreds of tissue.

"2. Ability to feel the fetal parts suspiciously close beneath the abdominal wall . . .

"3. The most important is finding the uterine cavity short and empty."

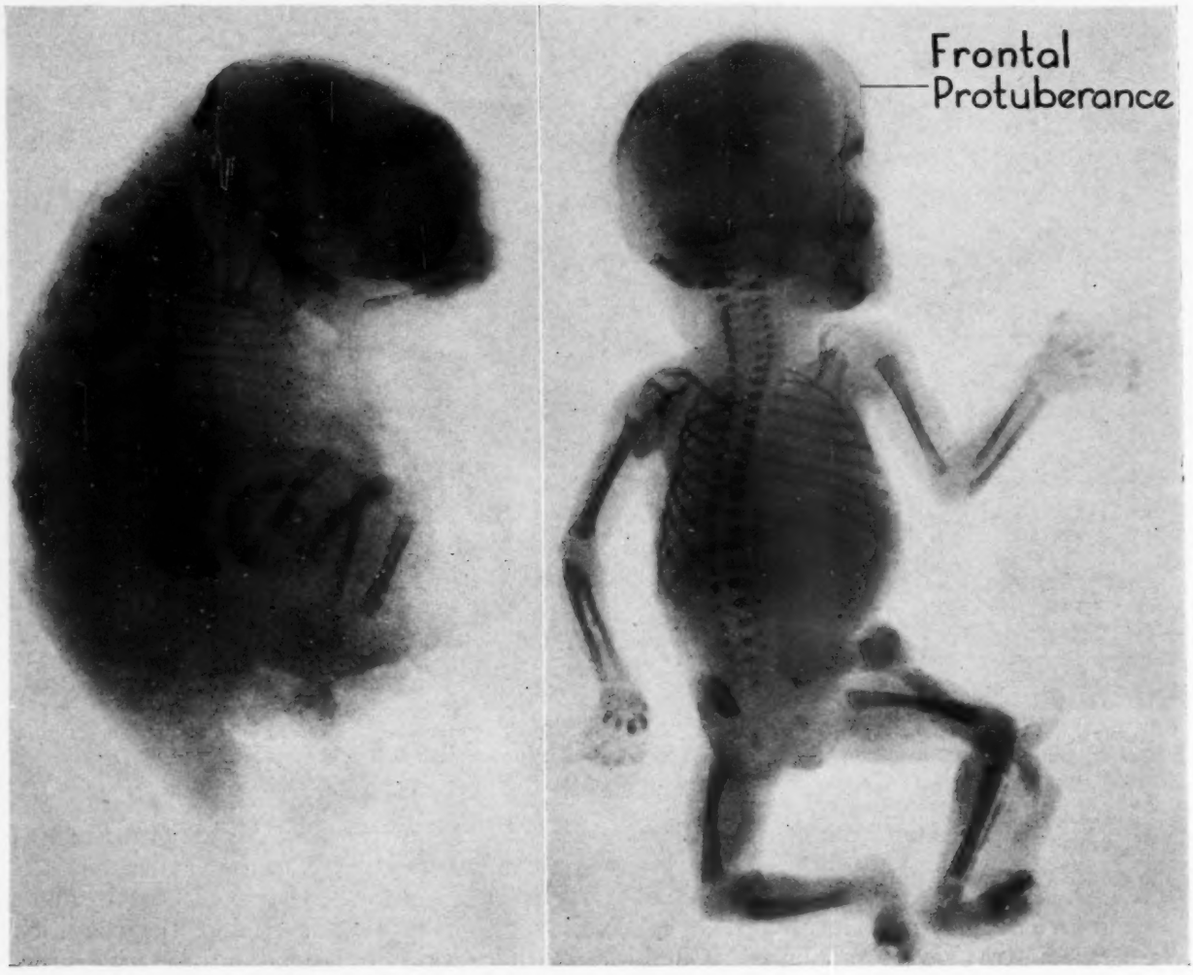


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FIG. 20. Case VI, V. M. Abdominal pregnancy; roentgenogram of fetus in sac after removal from abdominal cavity; note frontal protuberance.

FIG. 21. Case VI, V. M. Abdominal pregnancy; roentgenogram of fetus after removal from sac; menstrual age nineteen weeks. Bony rudiments of milk teeth are seen. Ossification centers are discernible in the arches of the uppermost eleven vertebrae and in the phalanges of the fingers. These findings are consistent with a menstrual age of nineteen weeks. Ossification center of horizontal ramus of pubis is not seen; this does not usually appear before twenty weeks. The frontal protuberance is an anomaly.

A low voltage roentgenogram may reveal that the wall of the uterus does not envelop the fetus. Whenever it is possible to inject opaque media into the uterus and take a hysterogram, it will be observed that the uterine cavity does not contain the fetus. It is not always possible to administer the injection because the cervix may be very high and attempts to inject opaque media may fail. (Fig. 24, Case VII.)

### OVARIAN PREGNANCY

The symptoms of ovarian pregnancy are the same as those of tubal gestation. According to Falls (1941), rupture with relatively severe hemorrhage occurs about the sixth or eighth week. On pelvic examination of very thin patients the ovarian sac can be felt as a cystic ovary rather than a dilated tube (Falls, 1941). The symptoms presented by this ectopic condition seldom enable the physician to make a preoperative diagnosis of ovarian pregnancy.

Norris believes that ovarian pregnancy is most easily diagnosed before it is six or eight weeks old because the gestation sac later grows so large that its relation to the surrounding parts is changed. Greenhill states that one cannot make a preoperative diagnosis of ovarian pregnancy; only a diagnosis of

ectopic gestation can be made. Operation establishes the clinical diagnosis. According to Wilson and Robins, ovarian pregnancy cannot be differentiated absolutely from tubal pregnancy before operation. The same authors call attention to the difficulty of distinguishing macroscopically between ovarian pregnancy and endometrial (chocolate) cyst. Schumann states that confirmation of a diagnosis of ovarian gestation can be made only by thorough microscopic examination.

In my series only tubo-ovarian cases were observed; no primary ovarian pregnancies were encountered. (Fig. 21, Case VI; Figs. 37 and 38, Case IX.)

### CERVICAL PREGNANCY

Studdiford (1945) states that cervical pregnancy is a very rare condition and one that presents serious problems which sometimes terminate fatally. (Fig. 14.)

The most common sign of this unusual form of ectopic gestation is hemorrhagic vaginal discharge which often appears so early that amenorrhea may be absent. The bleeding has a tendency to increase in quantity as the pregnancy advances. Amenorrhea is sometimes reported. There may be nausea, indefinite lower abdominal pain, backache and urinary complications. In most instances it is the painless vaginal bleeding which compels the patient to seek medical aid. The usual symptoms resulting from hemorrhage are manifested in patients who have experienced massive bleeding. If the gestation is of more than three months' duration, abdominal examination will reveal a pelvic mass commensurate with the length of the condition. The uterus, firmer and smaller than the mass, will be adherent to it. Sometimes the uterus is thought to be a uterine fibroid.

Pelvic examination reveals uterine bleeding. The cervix is enlarged to correspond with the age of the gestation. If the age is more than twelve weeks, the external os will be partially dilated, permitting identification of the sac and occasionally the lower edge of the placenta (Studdiford, 1945).

### DIAGNOSTIC AIDS

The experienced surgeon knows that the most valuable diagnostic aid in ectopic gestation is a good history. In my opinion there is no gynecologic condition in which a meticulous history is of greater importance. Symptoms may differ in different individuals but the history usually follows a characteristic course. After the patient has reported the more common symptoms which point to an ectopic pregnancy (amenorrhea, pain or hemorrhagic vaginal discharge), the physician should question her regarding possible etiologic factors, *e.g.*, salpingitis, previous pregnancies, relative sterility and pelvic and abdominal operations. In urgent cases, when there is no time for physical examination or diagnostic tests, the symptoms recited by the patient and her general physical appearance should be convincing evidence of the need for immediate surgical intervention.

The following are diagnostic procedures which should assist the physician in arriving at a correct preoperative diagnosis in non-urgent cases.

*Aschheim-Zondek or Friedman Tests.* These are positive in the presence of functioning chorionic villi. According to Titus, they continue to be positive from seven to ten days after the fetus has died. They do not differentiate between intra-uterine and extra-uterine pregnancy. In the absence of pregnancy but in the presence of some other disorders (chorionepithelioma, hydatidiform mole, para-ovarian cyst, embryonal adenocarcinoma or missed abortion) these biologic tests produce a misleading positive result. Because forty-eight hours must elapse before the result is known, these tests cannot be used in emergencies.

The Aschheim-Zondek test or any of its modifications may be of value in atypical cases where diagnosis is questionable. In such cases, if the results are negative, it is necessary to await further developments, but the patient should be in the hospital under observation until the diagnosis can be established. Such temporizing sometimes prevents unnecessary operation. On the other hand, some patients may require immediate intervention. Therefore, each patient should be prepared for operative interference in case emergency arises.

In our series the Friedman modification of the Aschheim-Zondek test was done in fifty-three cases (30.6 per cent). In forty-three patients (24.9 per cent) the test was positive; in eight instances (4.6 per cent) it was negative and in 2 cases (1.2 per cent) the rabbits died and the patients were operated upon before

the test could be repeated. Since the majority of our patients were admitted to the hospital as emergencies, there was not sufficient time for an Aschheim-Zondek test. When it was possible to do a biologic test, it was often necessary to operate before the report from the laboratory was received.

*Falls-Freda Test.* This is a skin reaction test which yields a result thirty minutes after the subcutaneous injection of colostrum. In a pregnant patient no skin reaction takes place. If the patient is not pregnant, a marked redness around the site of injection persists for two to three hours. Frederick H. Falls (1941), one of the workers who developed this test, found it reliable in 85 per cent of the cases in which it was used. Casler prefers this procedure to the longer and more expensive Aschheim-Zondek and Friedman tests.

*Puncture of Douglas' Pouch.* Aspiration of Douglas' pouch is a relatively simple procedure which can be performed in a short time in the home, in the physician's office or in the hospital. If blood is aspirated, it usually indicates intraperitoneal bleeding. However, in one of my patients in whom aspiration of the cul-de-sac was employed, laparotomy revealed that there was no blood in the peritoneal cavity; blood was evidently obtained from a varicose vein.

Burch and Seitchik, who consider aspiration of the cul-de-sac the most valuable single diagnostic aid in ectopic gestation, recommend abdominal aspiration if vaginal puncture is not advisable. These authors examine peritoneal blood for color, viscosity, presence of small clots and clotting time.

Authorities differ on the diagnostic value of cul-de-sac puncture. Mathieu believes it is important from the standpoint of treatment as well as diagnosis to know the character of fluid which is palpated in this region. Ware and Winn (1946) do not believe in this procedure because they say blood cannot be aspirated from an organized clot and the procedure increases the danger of infection. Schauffler and Wynia punctured the cul-de-sac in twelve of their cases without untoward effects and with definite positive results in eleven instances. They consider the procedure diagnostically valuable.

Falls (1941) subscribes with emphasis to the diagnostic value of cul-de-sac puncture. He has set down five conditions which should be met before the procedure is undertaken: (1) There should be a mass in the cul-de-sac sufficiently definite to indicate the direction of the diagnostic puncture. (2) The aspirating needle must be of sufficiently large bore to permit the passage of slightly clotted blood. Burch and Seitchik use a number 17 needle which they say permits withdrawal of small clots. (3) The vagina should be very carefully prepared as for a vaginal hysterectomy to avoid the possibility of carrying infection into the hematocele. (4) The needle should penetrate only as far as the hematocele and as soon as old blood is obtained, no further exploration should be attempted. (5) Even a small amount of liquid or clotted old blood should be interpreted as being sufficient evidence of ectopic pregnancy to indicate exploratory laparotomy even in the absence of other evidence of ruptured ectopic pregnancy.

Uterine fibromyomas, retroverted uteri and prolapsed adherent adnexae preclude the possibility of reaching the cul-de-sac but, of course, these conditions are apparent on pelvic examination.

*Posterior Colpotomy.* This procedure is only occasionally of diagnostic assistance. It differentiates pelvic hematocele from other cul-de-sac masses, such as abscess. Torpin (1944) makes liberal use of this confirmatory diagnostic aid. He states the affected tube can be removed through the colpotomy incision or through a laparotomy incision following suture closure of the colpotomy opening. Allen favors this technic for the same reason. He reports that when the affected tube or ovary is removed *per vaginam*, the length of hospitalization, the postoperative discomforts and the maternal risk are greatly reduced. DeLee and Greenhill (1943) recommend the frequent employment of this diagnostic aid. It permits drainage of any infected condition of the peritoneum. However, this is a more formidable procedure than puncture and aspiration of the cul-de-sac and convalescence may be stormy because of the possibility of excessive bleeding and infection due to excellent cultural conditions.

*Uterine Curettage.* To make an absolute diagnosis of ectopic gestation by means of uterine curettage, the curettement should yield chorionic villi. The absence of chorionic villi indicates: (1) ectopic gestation; (2) site of nidation was missed in the curettage and (3) the chorionic villi degenerated and sloughed away. However, one must always consider the

possibility of *combined* simultaneous intra-uterine and extra-uterine gestation.

In urgent cases there is no time for curettage. The procedure has its dangers for in the presence of tubal abortion or partial tubal rupture it may result in fatal massive intra-peritoneal hemorrhage.

Because of the confusing picture it may present and because the physician is often working against time, uterine curettement has limited value as a diagnostic aid in ectopic gestation.

*Peritoneoscopy*. This procedure can be of value in differential diagnosis and while it is more ambitious than puncture of Douglas' pouch, it involves no risks when carried out by a skilled technician. However, it is not a simple procedure and its use should be restricted to those who are familiar with the insertion of the instrument and who are competent to evaluate what it reveals. Scheffey prefers peritoneoscopy to either cul-de-sac puncture or posterior colpotomy.

*Hysterosalpingography*. The injection of opaque media into the uterus followed by x-ray examination in cases of suspected abdominal gestation reveals conclusively the presence of an extra-uterine pregnancy. A roentgenogram of an abdominal gestation without the injection of an opaque substance into the uterus will often reveal a living or a dead fetus in an abnormal position, but it will not prove that the gestation is extra-uterine. (Fig. 19, Case VI.)

When a roentgenogram reveals an apparently dead fetus (collapsed skull with or without other signs of fetal death) and there is strong suspicion of ectopic gestation, there is no danger in injecting opaque media into the uterus whether the pregnancy is intra- or extra-uterine. Hysterography is advisable when the fetus is dead and all attempts to bring about its expulsion by medicinal and mechanical means fail.

If the fetus is alive and the diagnosis is doubtful, injection of an opaque substance into the uterus may produce abortion should the pregnancy be intra-uterine. As previously stated, a low voltage roentgenogram may show that the uterine wall does not surround the fetal parts. (Fig. 23, Case VII and Fig. 27, Case VIII.)

Mathieu recommends hysterosalpingography to differentiate between ectopic gestation and rupture of a graafian follicle or corpus luteum. Falls (1941) advocates this procedure to establish a diagnosis when interstitial or abdominal pregnancy or lithopedion is suspected. Torpin (1944) does not favor x-ray examination because of the time it requires and because he believes it frequently yields indecisive results. Beacham and Beacham in their study of abdominal pregnancy observed no gestations that were disturbed in procuring uterograms or uterosalpingograms.

Hysterosalpingography like tubal insufflation may be followed by ectopic pregnancy. The tube becomes patent but is still not healthy, and the same factors that operate in any abnormal tube may persist after hysterosalpingography or insufflation. In other words, the peristalsis of the tube may be affected; the tubal mucous membrane may be so pathologically altered that ectopic gestation is likely to occur. If the irritation produced by ordinary opaque media had increased the incidence of tubal pregnancies, we would have had a far larger number of such gestations, as thousands upon thousands of women have been subjected to hysterosalpingography and have subsequently had normal uterine pregnancies.

In my experience hysterosalpingography done with opaque media not readily absorbable has not been responsible for tubal pregnancies. In such cases pre-existing pathologic conditions of the tubes were responsible.

*Urobilinogen and Icterus Index Tests*. Since these tests reveal the presence of a large hematoma or of blood undergoing absorption, they may be useful as differential diagnostic aids. Icterus accompanied by a rise in temperature signifies decomposition of the products of gestation. Mathieu found these tests valuable in arriving at a correct diagnosis in ectopic gestation.

### DIFFERENTIAL DIAGNOSIS

The numerous incorrect preoperative diagnoses reported in the literature afford abundant evidence that ectopic gestation produces symptoms similar to those of many other pelvic and abdominal conditions.

In this series 159 (91.9 per cent) of the 173 cases were correctly diagnosed preoperatively. The remaining fourteen cases (8.1 per cent) were incorrectly diagnosed as indicated in Table VI:

In the experience of other authors it is of interest to note the percentage of correct preoperative diagnoses as shown in Table VII:

According to Novak (1944) the percentage of error reported by all authors varies from 15 to 35 per cent. DeLee and Greenhill (1947)

TABLE VI

| Preoperative Diagnosis | No. of Cases | Postoperative Diagnosis |
|---|---|---|
| Appendicitis | 4 | Right ruptured tubal pregnancy |
| Diseased adnexa | 1 | Right ruptured tubal pregnancy |
| Diseased adnexa and fibromyoma of uterus. | 1 | Left unruptured tubal pregnancy and fibromyoma of uterus |
| Submucous fibroid of uterus. | 1 | Submucous fibroid of uterus and right unruptured tubal pregnancy |
| Ovarian cyst | 1 | Left unruptured tubal pregnancy |
| Ovarian cyst | 1 | Left tubal pregnancy and right hematosalpinx |
| Incomplete abortion | 2 | Right ruptured tubal pregnancy |
| Incomplete abortion | 1 | Right ruptured tubal pregnancy and left hydrosalpinx with left ovarian cyst |
| Intestinal obstruction | 1 | Right ruptured tubal pregnancy |
| Intra-uterine pregnancy with fibromyoma of uterus. | 1 | Left ruptured tubal pregnancy (isthmial) and fibromyoma of uterus |

TABLE VII

| Series | No. of Cases | Per cent |
|---|---|---|
| Fitzgerald and Brewer | 500 | 60.4 |
| Langman and Goldblatt | 310 | 81.3 |
| Marchetti et al | 141 | 87.9 |
| Nucci | 150 | 79.4 |
| Schauffler and Wynia | 65 | 80.0 |
| Torpin (1944) | 80 | 88.7 |
| Ware and Winn (1946) | 115 | 89.0 |

believe that "no pelvic condition gives rise to more diagnostic errors." Yet Titus maintains that even before rupture or abortion tubal gestation no longer presents unusual diagnostic difficulties. Errors that occur result from failure to differentiate this protean condition from other pelvic or abdominal entities presenting a similar prodromal picture. Many pathologic states which simulate ectopic gestation are also fulgurant abdominal emergencies (acute appendicitis, perforation of a gastric or a duodenal ulcer, rupture of a pus tube, rupture of the spleen) and the immediate surgical intervention which they demand settles all diagnostic questions.

Differential diagnosis is necessary chiefly in the atypical case in which vague and limited symptoms mask an unruptured ectopic pregnancy, a slow-leaking rupture or a walled-off hemorrhage. The surgeon of today will agree with Lawson Tait's observation, "The diagnosis of tubal pregnancy before rupture of the tube is not easy . . . because the patients do not claim our attention."

On the other hand, the clinical picture in typical ectopic pregnancy is usually sufficiently clear that a correct preoperative diagnosis can be established promptly. This, of course, is fortunate because, with the patient's life hanging in the balance, there is no time for the employment of diagnostic aids, many of which are time-consuming. Again Tait's remark is timely: "The diagnosis of tubal pregnancy at the time of rupture may be made with certainty seven times out of eight, and may be guessed at in the eighth instance."

All patients suspected of having an ectopic gestation should be kept under observation in the hospital until a differential diagnosis is established. Such a procedure will often change an erroneous admission diagnosis to a correct preoperative one.

Even the most experienced and skillful surgeon cannot avoid occasional diagnostic errors in ectopic gestation because of concomitant pathologic conditions frequently encountered, the vagaries of symptoms and the similarity of this condition to other obstetric and gynecologic states (Nucci). Whenever there is doubt about the diagnosis and temporizing seems justified, the surgeon has a number of diagnostic aids at his disposal.

According to Torpin (1945) the three most common causes of diagnostic error, in the approximate order of their incidence, are salpingitis, uterine abortion and appendicitis. Mathieu considers acute appendicitis, salpingitis and twisted ovarian cyst the most frequent conditions necessitating differential

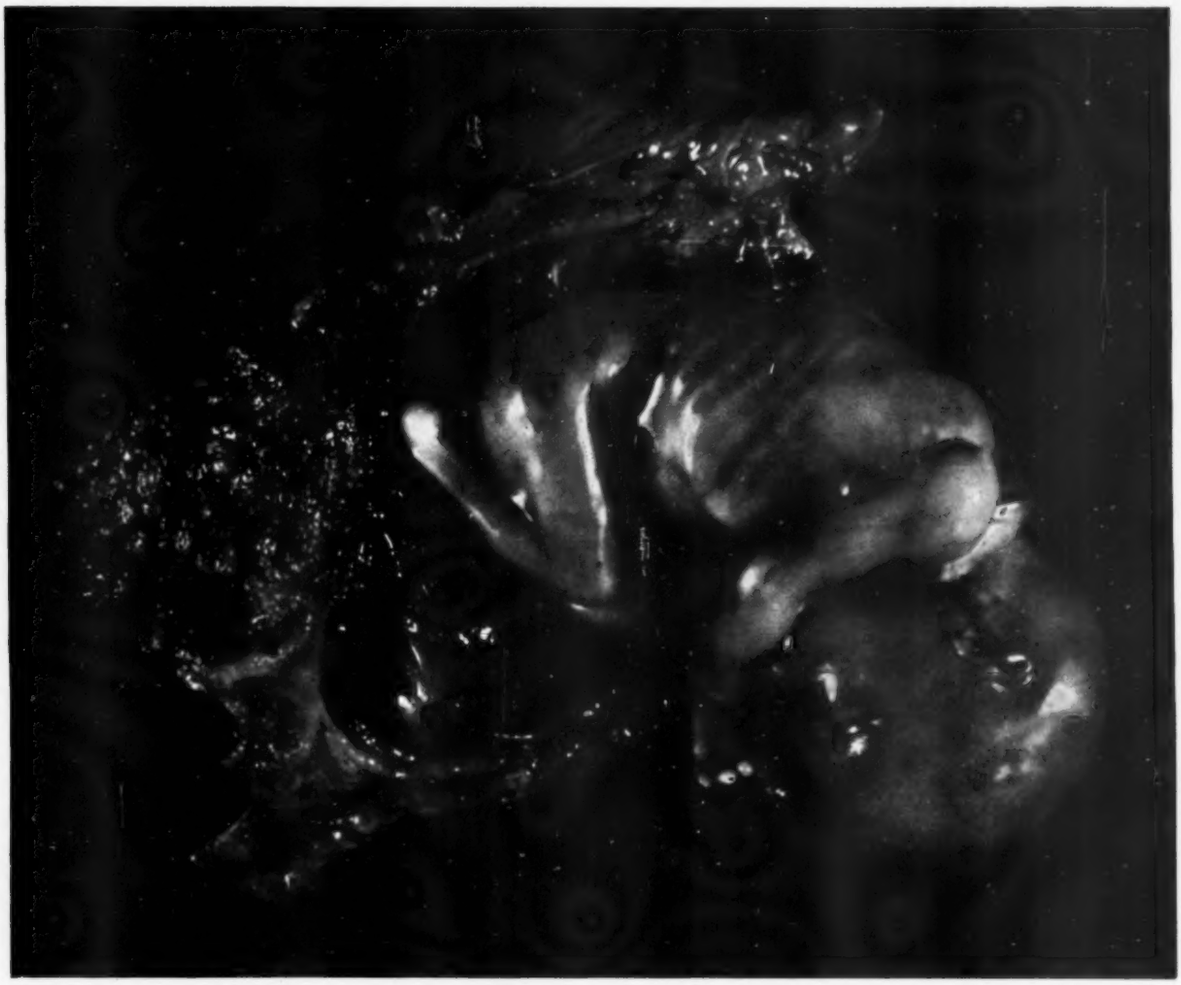

FIG. 22. Case VI, V. M. Abdominal pregnancy. The fetus shows a large frontal protuberance. The sac is formed by both the fallopian tube and the ovary. This is the same case as shown in Figures 20 and 21.

diagnosis. Chronic salpingo-oophoritis is often a cause of difficulty in differential diagnosis. Common conditions necessitating differential diagnosis from ectopic gestation follow:

*Abortion, Uterine.* The symptoms of early pregnancy and hemorrhagic vaginal discharge characterize this condition. The bleeding lasts longer and is more profuse than in ectopic gestation. The blood is bright red. Occasionally placental tissue is passed. Unilateral mass and abdominal tenderness are absent. The uterus is apt to be softer and its size will correspond to the duration of amenorrhea. The pain is less severe and is referred to the midline rather than to one side. Novak (1944) advocates the use of pelvic puncture as a diagnostic aid. The presence of considerable blood indicates ectopic gestation. Curettage where chorionic villi are not found favors ectopic pregnancy. Curettage is to be done with great care because of the danger of massive hemorrhage should a partial rupture or tubal abortion have occurred.

*Angular pregnancy* is located in one horn of the uterus. The affected side becomes distended. According to DeLee and Greenhill (1947) this condition is a frequent cause of incorrect diagnosis and it cannot be distinguished "from interstitial pregnancy except by the clinical course."

*Appendicitis* occasions many diagnostic errors in cases of ectopic gestation. The symptoms of early pregnancy are absent. Diagnostic error often occurs when the menstrual period coincides with severe pain in the right lower quadrant, accompanied by rigidity of the right rectus muscle and leukocytosis. At the onset, however, pain is usually localized around the umbilicus or in the epigastrium. The nausea and vomiting of appendicitis may also add to the diagnostic confusion. Appendicitis may occur in early pregnancy; and if there is any question about the diagnosis, laparotomy should be performed.

*Corpus luteum rupture* may result in intraperitoneal hemorrhage with pain and sometimes shock, thus simulating ectopic rupture. I have encountered two cases of this type.

While on her honeymoon, and before she had had sexual relations, one of my patients developed signs of intra-abdominal bleeding. To their dismay, the young couple was informed that the wife required immediate operation for hemorrhage caused by ruptured extra-uterine pregnancy. However, laparotomy revealed extensive hemorrhage from a ruptured corpus luteum.

The second case was that of a patient who came to me with a history of having been operated upon six weeks previously for ruptured graafian follicle with severe hemorrhage and removal of the right ovary. Her statement was confirmed by the surgeon who performed the operation. I treated her for sterility and two years later delivered her of twins.

The sudden onset of severe lancinating lower abdominal pain, sometimes unilateral, sometimes generalized; abdominal tenderness and rigidity, perhaps accompanied by anemia, signs of massive abdominal hemorrhage, peritoneal irritation, nausea, vomiting and shock, all of which may be encountered in spontaneous rupture of the corpus luteum, may cause the condition to simulate ectopic gestation. Shock is out of proportion to the blood loss. Fever and leukocytosis are usual. On examination there is generalized vaginal sensitivity. Corpus luteum rupture usually takes place immediately before the onset of the menses. Any diagnostic question can be settled by puncture of the cul-de-sac. If blood is found, ectopic gestation cannot be excluded.

*Cysts.* Marchetti et al. attributed some of their diagnostic errors to four types of ovarian cysts: corpus luteum cysts, simple serous cysts, cysts with twisted pedicle and endometrial cysts.

A *corpus luteum cyst* presents many symptoms of an unruptured tubal pregnancy or of a tubal abortion. The Aschheim-Zondek test is falsely positive. There may be menstrual delay, followed by the hemorrhagic vaginal discharge characteristic of ectopic gestation. The enlarged ovary presents a tender unilateral mass, simulating the mass of tubal gestation.

*Endometrial (Chocolate) Cyst.* Because of the marked resemblance between the two conditions, macroscopic examination frequently fails to distinguish ovarian pregnancy from endometrial cyst (Wilson and Robins).

*Ovarian cyst with twisted pedicle* may give rise to diagnostic confusion. The sudden, severe pain accompanied by nausea and vomiting may occur in both conditions, *i. e.*, in ovarian cyst with twisted pedicle and in ectopic rupture. In the former condition the twisted pedicle is responsible for these symptoms. While there

is no history of amenorrhea in ovarian cyst, this symptom is likely to be present in ectopic gestation. Frequently the history includes prolonged menstrual irregularity and the existence of an ovarian cyst, which may be palpated on abdominal examination. If time would permit, biologic tests would be of assistance because their result would be negative. However, as ovarian cyst with twisted pedicle is a condition that usually demands immediate surgical intervention there is no time to employ these diagnostic aids. Mathieu considers twisted ovarian cyst one of the most common pathologic states to be distinguished from ectopic gestation.

*Fibromyomas* are reported by many authors as a cause of incorrect diagnosis in ectopic gestation. In my experience fibromyomas are often associated with other pathologic conditions: inflamed adnexae, cystic ovaries or ovarian cysts of varying sizes, abortion, and when least suspected unruptured ectopic gestation of recent or long-standing origin. In general, when there are masses in the pelvis the uterus is likely to remain unchanged except for slight enlargement in the early weeks of ectopic gestation or when myomas of the uterus are present.

*Graafian Follicle, Ruptured.* The pain, intraperitoneal hemorrhage and shock accompanying this condition, which usually takes place at the *mid-menstrual interval* make it very difficult to differentiate from ectopic gestation. A uterosalpingogram is of great assistance in establishing the diagnosis. It will exclude tubal gestation but will not exclude early primary ovarian pregnancy.

*Hematosalpinx.* Many cases of hematosalpinx are undiagnosed ectopic pregnancies. Although the history of the patient may be at variance with the findings, I believe that in encountering hematosalpinx the first thought should be of ectopic gestation. Even at laparotomy cases of hematosalpinx cannot always be differentiated grossly from tubal pregnancy. (Case v.)

In this case the history was not typical of ectopic gestation. Before operation a diagnosis of ovarian cyst was made. When the abdomen was opened a hematosalpinx was found. Grossly and microscopically there was no indication of ectopic pregnancy; the tube showed chronic inflammatory reaction and thickening. However, in many sections of the blood clot degenerated chorionic villi were found. (Figs. 17 and 18.) Unfortunately, a biologic pregnancy test was not done since ectopic pregnancy was not suspected. Had a biologic test been made, the result might have been negative because the chorionic villi were degenerated and detached from the tubal wall; in all probability the trophoblasts were not functioning.

In another patient operated upon for ectopic pregnancy a left ruptured tubal pregnancy and a right hematosalpinx were found. It is my impression that this case was a bilateral tubal pregnancy. Grossly the left tube showed a fetus and sac. No fetus was found in the right tube. Evidently a thorough microscopic examination was not done in this case because of the exigencies of war. Therefore, there was no conclusive evidence that there was a pregnancy in the right tube.

*Hematoma or Hematocele, Infected.* These conditions make differentiation from pelvic cellulitis, perimetritis or pyosalpinx virtually impossible without cul-de-sac puncture or colpotomy to demonstrate the hemorrhagic character of the pelvic mass. Jaundice is a valuable diagnostic aid since it is usually concomitant with autolysis of blood.

*Hydrosalpinx.* The presence of fluid in the tube gives rise to distention which may cause severe pain and present a tubal outline simulating that of ectopic gestation.

*Intra-uterine Gestation, Complications.* Several conditions accompanying a normal intrauterine gestation present a symptom complex which causes the surgeon to suspect ectopic pregnancy. These include ovarian cyst, fibromyomas, soft uterine wall with an extreme lateral rotation, pregnancy in a retroflexed uterus and a large corpus luteum. A retroverted gravid uterus, like a pelvic hematocele, may be accompanied by anuria. If there is in addition some hemorrhagic vaginal discharge caused by threatened abortion, the suspicion of ectopic gestation increases. The passage of a catheter will at times clear up any diagnostic doubt because it permits more satisfactory uterine palpation.

*Pancreatitis, Acute.* The onset of this condition with its sudden, severe abdominal pain and distention, vomiting, nausea and abdominal tenderness may result in an incorrect diagnosis of ectopic gestation.

*Pelvic Inflammatory Disease.* Many writers report some diseased condition of the pelvic

organs as a cause of diagnostic confusion in ectopic gestation. Gonorrheal salpingitis is the most common offender. As Nucci points out, the cause of this confusion is to be found in the fact that two of the most universal symptoms of ectopic gestation—abdominal pain and hemorrhagic vaginal discharge—occur also in salpingitis. However, the complete symptom complex of each condition possesses a sufficient number of dissimilar features to enable the physician to make a correct diagnosis in spite of any common signs encountered.

The pain in gonorrhea usually coincides with or immediately follows the menses. It is unremitting whereas ectopic pain is usually intermittent. While there may be a hemorrhagic vaginal discharge, this is not so frequent as that encountered in ectopic gestation.

In gonorrhea the physical examination usually reveals a bilateral adnexal mass although the mass on one side may be much larger than on the other, giving the impression of a unilateral formation (Novak, 1944). In gonorrhea there is lower abdominal rigidity; but in ectopic gestation, if rigidity is encountered, it is restricted to the side of the pregnancy.

Laboratory tests will often clarify the diagnosis. Smears taken from the urethra and cervix, also cultures for gonococci are of great value. Gonorrhea is apt to produce a more rapid sedimentation rate than ectopic gestation. In ectopic gestation the leukocyte count is usually under 15,000, but in salpingitis the usual count is between 15,000 and 20,000. The temperature in pelvic inflammatory disease may rise to 103°F., but in ectopic pregnancy it seldom runs above 102°F. Farrar emphasizes the value of the fluctuating leukocyte count along with a slightly raised temperature in differentiating ectopic gestation from a purulent salpingitis. She found that the latter condition presents a more uniformly high leukocyte count and fluctuating temperature. In the presence of pregnancy the biologic tests are frequently positive whereas in gonorrhea they are negative. Blood in Douglas' pouch should rule out salpingitis. However, in one of my cases, aspiration of the posterior cul-de-sac brought out blood; immediate laparotomy revealed subacute adnexitis.

According to various authors the following conditions may present symptoms which necessitate differentiation from ectopic gestation: Carcinoma of fundus; carcinoma of ovary; cholecystitis; chorionepithelioma; dermoid cyst and intra-uterine pregnancy; endometrioma; hematoma of the rectus muscle; ileus; intestinal obstruction and intra-uterine pregnancy; myopathic bleeding; nephrolithiasis; ovarian hemorrhage; painful ovulation; pelvic abscess; perforation of a gastric or a duodenal ulcer; perforation of the stomach or duodenum; pregnancy in a bicornate uterus; primary anemia; renal colic; ruptured appendiceal abscess; ruptured follicular cyst; ruptured gallbladder; ruptured pyosalpinx; ruptured spleen; ruptured splenic artery; ruptured varicosities of broad ligament; tuberculous peritonitis; tubo-ovarian abscess; twisted ovarian tumor; twisted tube or ureteral stricture and ovarian cyst.

*Cervical Pregnancy.* A correct preoperative diagnosis is rare in cervical pregnancy. This type of gestation may be erroneously diagnosed as uterine abortion, placenta previa, cancer of the cervix, ruptured ectopic gestation, early uterine pregnancy complicated by fibroids, hematoma of the cervix and cervical fibroid (Studdiford, 1945).

The symptoms are most frequently interpreted to indicate some stage of uterine abortion. In the latter condition, however, painful uterine contractions and hemorrhages precede detachment of the ovum (Schneider).

## PATHOLOGIC ANATOMY

Lawson Tait, an outstanding pioneer in the field of extra-uterine pregnancy, was of the opinion that all ectopic gestations, with the possible exception of ovarian, must, in their origin, be tubal.

J. C. Webster, another leading authority, contended that in the light of knowledge then existing there were but three types of ectopic gestation: ampullar, interstitial and infundibular. It was his belief that as research into the subject progressed, other classes of extra-uterine implantation might be demonstrated. This opinion has been borne out during the intervening years, and newer knowledge has definitely established that an aberrant fertilized ovum can nidate in the tube, ovary, abdominal cavity (peritoneum) and, in extremely rare instances, in the cervix. In fact, as Kerr states, it is possible for the ovum to become implanted anywhere in the pelvic or abdominal cavity.

*Sites.* Extra-uterine gestations may be classified as tubal, ovarian, abdominal and cervical, but all authorities agree that the most frequent site for nidation of the ectopic ovum is the interior of the tube (Fig. 1) where it may take place either in the tubal wall (intra-columnar) or in a tubal fold (columnar). Woodhouse states that of all ectopic pregnancies, 95 to 98 per cent are found to be tubal pregnancies.

TABLE VIII

| Location | No. of Cases | Per cent |
|---|---|---|
| Isthmus | 57 | 35.8 |
| Ampulla | 51 | 32.1 |
| Entire tube (including hematosalpinx containing products of conception) | 17 | 10.7 |
| Fimbria | 12 | 7.5 |
| Abdominal cavity | 9 | 5.7 |
| Interstitial portion of tube | 8 | 5.0 |
| Cornu | 2 | 1.3 |
| Tubo-ovarian: fimbria-ovarian | 2 | 1.3 |
| Rudimentary horn | 1 | 0.6 |

ectopic ovum may lodge and begin its development as follows: (1) ampulla; (2) isthmus and (3), the interstitial portion of the tube. In rare cases, implantation may occur upon (4) the fimbriated extremity and sometimes upon the (5) tubo-ovarian (fimbria ovarica). Titus lists ovarian pregnancy as the sixth type of extra-uterine gestation and abdominal pregnancy as the seventh type.

While authorities differ on the relative incidence of all types of tubal implantation, the overwhelming consensus of opinion favors the ampulla as the site of greatest frequency. The great width of the tube at this point and the excellent vascular supply are in all likelihood responsible for the high proportion of ampullary nidations (Kerr). The isthmus is second choice for tubal nidation. Implantation in the fimbriated extremity and in the interstitial portion is of low frequency.

In nine series totaling 1225 cases of ectopic gestation, the frequency of occurrence was as follows: ampulla, 578; isthmus, 265; fimbriated extremity, 71; interstitial portion, 45; infundibular, 31; entire tube (including hematosalpinx containing products of conception), 17; abdomen, 17; distal half of tube, 10; distal two-thirds of tube, 6; broad ligament, 5; entire tube and ovary, 5; ovary, 5; cornu, 3; tubo-ovarian, 2, and rudimentary horn, 1. The site in the remaining cases was not stated, or, if stated, not proven. (Table IX.)

TABLE IX

LOCATION OF ECTOPIC OVUM IN 1225 CASES

*(As Reported by Nine Authors)*

| Series | No. of Cases | Ampulla | Isthmus | Fimbriated Extremity | Interstitial Portion | Infundibular | Entire Tube | Abdomen | Distal Half of Tube | Distal Two-thirds of Tube | Broad Ligament | Entire Tube and Ovary | Ovary | Cornu | Tubo-ovarian | Rudimentary Horn |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Falk and Rosenbloom | 313 | 165 | 34 | .. | 14 | | | | | | | | | | | |
| Foskett | 117 | 52 | 64 | .. | 1 | | | | | | | | | | | |
| Jarcho | 173 | 51 | 57 | 12 | 8 | .. | 17 | 9 | .. | .. | .. | .. | .. | 2 | 2 | 1 |
| Lise et al | 115 | 75 | 26 | .. | 7 | .. | .. | 3 | .. | .. | .. | .. | 2 | | | |
| MacFarlane and Sparling | 110 | 67 | 32 | .. | 7 | .. | .. | 3 | | | | | | | | |
| Nucci | 150 | 62 | 23 | 59 | 1 | .. | .. | 2 | .. | .. | .. | .. | 2 | | | |
| Sadler | 102 | 32 | 17 | .. | 3 | .. | .. | .. | 1 | 6 | 5 | 5 | | | | |
| Schauffler and Wynia | 65 | 9 | 14 | .. | 1 | 31 | .. | .. | .. | .. | .. | .. | .. | 1 | | |
| Torpin | 80 | 65 | 8 | .. | 3 | .. | .. | .. | .. | .. | .. | .. | 1 | | | |
| Totals | 1225* | 578 | 265 | 71 | 45 | 31 | 17 | 17 | 10 | 6 | 5 | 5 | 5 | 3 | 2 | 1 |

* Includes 164 cases in which site was not stated, or, if stated, not proven.

In 159 cases (91.9 per cent) in this series the ovum was located at the site indicated in Table VIII:

The tubal pregnancy occurred on the right side in ninety cases (52.0 per cent), on the left side in seventy-three cases (42.2 per cent) and was bilateral in one case (0.6 per cent). In nine cases (5.2 per cent) the ectopic pregnancy occurred in the abdominal cavity.

Titus outlines the various sites where an

Although tubal implantation is by far the most common ectopic type, the occurrence of primary implantation in the ovary, peritoneal cavity and cervix is now generally conceded

by leading pathologists. Ectopic gestation has also been known to occur in an endometrial pocket in the wall of a uterus harboring adenomyosis (Doederlein and Herzog).

The most significant difference between uterine and extra-uterine gestations is found in their decidual formations. The uterine decidua is a thick, massive membrane, admirably adapted for its ordained function. Its structure enables it to shelter the ovum, to protect the uterine musculature from the erosive action of the trophoblast, to provide for the formation of the decidua capsularis and to nourish the ovum until a normal placental circulation is established from small blood vessels.

In ectopic gestation, on the other hand, decidual reaction is imperfect, scanty and incomplete. The pathologic changes brought about by this condition are determined by the site of implantation and the length of time which elapses before trophoblastic erosion into large, unguarded blood vessels causes uncontrollable hemorrhage.

The ovum nidates in an ectopic nidus in the same manner in which normal implantation occurs, i.e., when the trophoblast has developed it erodes into the nearby mucous membrane. There it encounters an anatomic structure different from that in the uterus and its pathologic course is influenced thereby.

Ectopic gestation may terminate in: (1) Early death of the embryo, with complete absorption of the products of gestation. (Case v); (2) development to an advanced stage or, less frequently, to term, in the site of primary nidation. (Cases vi, vii, viii and ix); (3) rupture.

If rupture occurs, three courses are open to the ovum: (1) It may perish; (2) it may continue development in the site of secondary implantation (Case iv); or (3) although rupture may change its position, its placental attachments may not be disturbed and development will continue in the site of primary nidation (H. E. Miller).

Grier states, "One should keep in mind the pathology as it appears in the three different phases, namely, before rupture, at the time of rupture, and sometime after rupture. Each has its own peculiar picture."

*Pathologic Changes in Tubal Gestation.* Because the uterus and tubes are both derived from Müllerian tissue, their physiologic reaction to gestation is the same; but because the anatomy of the tube cannot accommodate a developing ovum, the result of tubal nidation is always pathologic. Damage to the blood vessels is the most significant pathologic feature of tubal pregnancy (Kerr).

In uterine gestation the blood vessels of the uterine musculature are not eroded. Tubal gestation, however, lacks a true decidua and submucosa; hence the ovum penetrates the mucous membrane and almost at once meets the inner tubal muscular layer. The ovum penetrates large unprotected vessels, producing hemorrhage. This tubal hemorrhage is often so great that the villi are disrupted and the ovum capsule so overdistended that the blood pours forth into the wall or peritoneal cavity. Or there may be rupture of the internal capsule into the tubal lumen—the condition usually referred to as tubal abortion. Litzenberg (1937) says, "From this same source, blood extravasates into the capsularis and between the muscle fibers along the tube wall, toward the fimbriated extremity or toward the uterus." In his wide experience he never examined an ectopic tube in which there had not been intracapsular hemorrhage. Rock says, "The aperture through which it [the ovum] enters closes over it, and it becomes completely surrounded by maternal tissue. Thus failing to grow on the surface, it forces the maternal envelope to stretch almost indefinitely, a quality possessed only by the uterus, the peritoneum, and sometimes the ovary."

From the nutritional standpoint the tube is an unfavorable nidus and the ovum usually perishes in the early weeks. According to Te Linde tubal abortion occurs, as a rule, between the sixth and twelfth weeks of pregnancy. Whether an ectopic pregnancy will continue as a secondary implantation is determined by the condition of the ovum and the extent of hemorrhage at the time of rupture (Beacham and Beacham). According to Rock in over 80 per cent of cases fetal death precedes or is approximately coincidental with the appearance of symptoms. Bleeding into the peritoneal cavity results in a hematocele; bleeding into the tubal lumen causes hematosalpinx.

Many cases of hematosalpinx are undiagnosed ectopic pregnancies. When encountering a hematosalpinx, I am of the opinion, as previously mentioned, that the first thought should be of the possibility of an ectopic gestation.

In tubal gestation there is a capsularis, but, as Litzenberg says, it cannot be termed decidua capsularis because decidual reaction is so sparse. The tubal capsularis is fundamentally weak; it does not stretch or develop. What strength it possesses is reduced by the attacking villi, making it easy prey to rupture.

Writers are in general agreement (Novak, DeLee and Greenhill, Kerr, Litzenberg) that there is very little decidual reaction in the tube and few decidual cells are present. What decidual reaction is demonstrable is imperfect and unlike the characteristic uterine decidua. Investigators who report the presence of numerous decidual cells undoubtedly mistake these for trophoblast cells. As Novak (1947) states: "The trophoblast can, in properly cut sections, be traced by direct continuity far out into the tubal wall, and there is no doubt that these invading cells have often been mistaken for decidua." Litzenberg (1937) points out that decidual reaction is sparsest at the site of nidation. It becomes more abundant the farther one goes from this point. It may be observed in the tubal peritoneum and in the fimbriated extremity. J. Whitridge Williams (1920) observed the most pronounced tubal decidua in the opposite non-gravid tube.

In some cases Litzenberg (1937) noted thickening of the tubal musculature in the vicinity of the implantation. The rest of the tubal musculature undergoes very little change except where the enlarging ovum extends it.

Microscopically, tubal gestation is evidenced by the presence of chorionic villi in the tubal lumen and on occasion in the wall. The villi may be quite normal in appearance or they may reflect pronounced degeneration and hyalinization (Novak, 1944). When manifesting minor evidence of change, the Langhans and syncytial cells comprising the trophoblastic epithelium can be readily distinguished. (Figs. 3, 4, 5, 6, 7 and 8, Case II; Figs. 11, 12 and 13, Case III and Figs. 17 and 18, Case V.)

The ovum grows rapidly and in the absence of a protective decidua, its behavior simulates that of a malignant neoplasm (DeLee and Greenhill, 1943). Columnar nidation eventuates in what is really a gravid polyp which of necessity is short lived (Litzenberg, 1937). The hypertrophy of the tubal musculature is unable to accommodate the enlarging ovum and eventually, as a result of the destructive action of the villi, a weak spot develops at the placental site. Then some unusual pelvic exertion, such as stretching, coitus, defecation, the use of abortifacients and sometimes vaginal examination may bring on a rupture with hemorrhage; or the tube may break from overdistention of its thin, eroded wall and the villi lie at large in the peritoneum, causing an extracapsular rupture. If rupture is on the free part of the tube, the escaping blood may collect gradually in Douglas' cul-de-sac or elsewhere in the pelvis. When the blood so amassed becomes encapsulated by peritoneal adhesions, a pelvic hematocele is formed. This is by far the most frequent termination of tubal gestation. Rupture of the tube into the broad ligament is of rare occurrence, but when it does take place a hematoma is formed there and the ovum usually perishes. More infrequently it may continue to develop. In this case the broad ligament becomes very much separated, the peritoneum is stripped off both bladder and rectum, and pushed up by the growing sac. The sac of this gestation seldom ruptures because it is firmly adherent to the neighboring structures (Kerr).

Leading authorities (Frank, Watson, Litzenberg, 1937) have questioned the distinction between the terms tubal abortion and tubal rupture as terminations of tubal gestation. Watson maintains that the two conditions are basically the same and a tubal abortion must be preceded by a tubal rupture. "In both cases the ovum ruptures through the tube wall, through the peritoneal aspect, or through the mucous membrane into the lumen" (Watson). Watson is of the opinion that while the clinical picture is less acute when rupture takes place in the lumen, the pathologic course of both processes is essentially the same.

Frank says that tubal abortion is a misnomer because it is not an abortion but an outgrowth into the lumen of the tube.

Litzenberg (1937) maintains that "internal rupture" is more accurate than "tubal abortion" because the latter, strictly speaking, is a separation of the ovum and its expulsion by the action of the tubal musculature. He doubts very much whether an ectopic tube, weakened by erosion and distention, has the power to extrude even a detached ovum. In his judgment if an ovum is expelled, the expulsion will be by hemorrhagic force. This authority prefers the terms external tubal rupture and internal tubal rupture to tubal

rupture and tubal abortion, respectively. I concur fully with his opinion.

While hemorrhage is characteristic of both intra-uterine abortion and internal tubal rupture, its origin and cause are different. In intra-uterine abortion hemorrhage is the result of separation of the ovum and the blood originates *beneath* the uterine decidua or placenta. In internal tubal rupture the inner ovum capsule breaks because of overdistention and the blood issues from large penetrated blood vessels.

In the experience of Schumann tubal rupture occurs twice as often as tubal abortion, and in that of Lavell, over three times as frequently. Hemorrhage, as a rule, is less severe in the condition termed abortion and may terminate with complete extrusion of the embryo. These atypical cases of complete embryonic expulsion sometimes result in spontaneous recovery. In incomplete embryonic abortion a slow hemorrhage from the tubal ostium persists, eventually forming a pelvic hematocele with symptoms necessitating surgical intervention.

In tubal rupture hemorrhage may persist whether the ovum has been expelled or not. The extent of intraperitoneal hemorrhage is not affected by the location of the rupture. Repeated rupture is the rule (Gordon, 1936). Blood, a peritoneal irritant, causes pain; hence, pain signifies rupture.

Most writers use the term unruptured tubal pregnancy to designate a tubal condition in which the tubal wall is intact. According to Litzenberg (1937) this designation is erroneous because even though no break in the tube can be detected, blood seeping through the ostium abdominale is proof of rupture of the internal embryonic capsule. He holds that blood in the peritoneal cavity is evidence that the ovum capsule is ruptured either externally or internally.

*Ampullar Gestation.* When nidation occurs in the ampullary portion of the tube, the pregnancy usually terminates in tubal abortion. Hemorrhage separates the ovum from its placental site, the sac may rupture and the fetus is extruded into the tubal lumen (DeLee and Greenhill, 1943). This process is known as intracapsular rupture. Blood seeps through the fimbriated extremity of the tube, slowly coagulating to form a lower pelvic hematocele. Eventually the ovum and blood clots are projected through the tubal opening into the abdominal cavity where they are finally absorbed unless removed by the surgeon. Occasionally an ampullary pregnancy may continue as a secondary abdominal gestation, provided that sufficient placental tissue remains attached to the tube. According to DeLee and Greenhill (1943) if the ovum remains in the tube, it gradually succumbs to hemorrhage and is converted into a *mola carnosa.* The mole may rupture but more often it disintegrates and forms a hematosalpinx. This condition is responsible for continued abdominal discomfort and irregular menstruation. Sometimes, although rarely, a pyosalpinx may form (Kerr).

*Isthmial Gestation.* Because the muscle fibers are not well developed and because the tubal lumen is too small at the isthmus to permit expansion of the fetal sac, gestations in this portion of the tube usually terminate by rupture with the formation of a pelvic hematocele, sometimes, according to Kerr, as early as the second or third week.

*Interstitial Gestation.* Far less frequent than ampullar and isthmial implantations, interstitial gestation is of marked interest, not only because of its relatively low incidence but also because it produces certain perils and problems not encountered in the more common forms. The greater vascularity of this part of the tube makes it the most hazardous site for a tubal pregnancy. (Figs. 9 to 13, Case III.)

While this type of nidation has been divided into groups, Wynne says that the simplest classification is: tubo-interstitial, utero-interstitial and interstitial proper. When the ectopic ovum selects as its host the uterine wall (portion of the tube surrounded by uterine muscle), a true interstitial pregnancy comes into being.

In the typical case the ovum grows in the uterine wall and penetrates the muscle layers. "The corner of the uterus" (Kerr) is displaced, resulting in distortion of the rest of the organ (DeLee and Greenhill, 1943). While rupture usually occurs during the second and third months (Grusetz and Polayes), it may be of later occurrence. The dense layer of uterine musculature surrounding the interstitial portion of the tube provides a more suitable site for development of the ovum than is found in the tubal wall. Interstitial gestation is very rare after six months.

According to Polak interstitial gestation

may terminate in one of the following ways: (1) By death of the ovum; (2) by expulsion of the ovum into the uterus, in which case the pregnancy may terminate as an abortion or proceed and develop as an intra-uterine pregnancy; (3) by rupture into the peritoneal cavity, with death of the mother from hemorrhage and shock; (4) the ovum may rupture into the broad ligament.

Rupture may occur into the uterus; more often it occurs into the abdominal cavity. Because of the large blood vessels in this region, hemorrhage from this rupture is massive. Hematocele is a frequent accompaniment.

Wynne sets forth the following criteria for interstitial gestation: (1) A fetus or fetal elements must be found, (2) uterine muscle must surround the fetal membranes except at the region of the rupture, (3) there must be no connection with the uterine cavity unless definite evidence of a rupture into it is found and (4) the isthmus of the tube must not be involved in the sac. (Figs. 9 and 10, Case III.)

*Ovarian Gestation.* Although of comparatively rare occurrence, ovarian gestation is not as infrequent as it was once believed to be. Curtis states that approximately 100 cases of true or primary ovarian gestation have been reported in the literature, but only about sixty of these appear to be authentic. He goes on to state that primary ovarian pregnancy may occur after fertilization in the fallopian tube, just as normal intra-uterine gestation develops after fertilization in the fallopian tube.

Ovarian gestation may be the result of (1) fertilization of an ovum which was not extruded from the ovary upon rupture of the graafian follicle; or of (2) fertilization of the ovum outside the ovary, with subsequent ovarian nidation. The first type is probably a primary ovarian implantation; whereas the other type may be termed secondary ovarian pregnancy because it is probably the result of a rupture of the ovum into the ovary from the primary site of nidation.

Implantation on or within the ovary presents many of the clinical features of the tubal varieties. Such a pregnancy may be (Fig. 1): (1) intrafollicular, with the ovum being fertilized within the follicle; (2) superficial, with implantation occurring on the surface of the ovary; (3) interstitial, with nidation taking place in he stroma of the ovary. The intrafollicular variety is the most common.

According to Kerr this ectopic gestation terminates at a comparatively early date. Three of his cases ruptured at about the fifth, seventh and eighth weeks. While rupture with hematocele, with or without fetal death, is the usual termination, a mole, sometimes of the hydatidiform type, may form. An ovarian hematoma may not be considered the result of a gestation unless fetal parts or chorionic villi can be demonstrated (DeLee and Greenhill, 1943).

The following four criteria for primary ovarian pregnancy were first formulated by Cohnstein in 1877 and again set forth by Spiegelberg in 1878. They are generally accepted by all authorities. (1) The tube on the affected side must be intact; (2) the gestation sac must occupy the position of the ovary; (3) the gestation sac must be connected with the uterus by the ovarian ligament; and (4) definite ovarian tissue must be found in the walls of the sac.

In commenting upon the fourth criterion, J. W. Williams (1903) states that ovarian tissue should be present in several distant parts of the sac wall because in some cases of tubal or broad ligament pregnancy the ovary may in some measure be incorporated in the sac wall. (Fig. 21, Case VI; Figs. 37 and 38, Case IX.)

*Abdominal Gestation.* Primary abdominal nidation is of such infrequent occurrence that many authorities have doubted the possibility of its existence. Others are of the opinion that a number of authentic cases of primary implantation and development in the peritoneal cavity have been recorded. Among the cases most frequently referred to in the literature, that seem to satisfy the criteria for this type of ectopic gestation, are those of Galabin (1896); Witthauer (1903); Hirst and Knipe (1908); Reifferscheid (1922); Studdiford (1942) and R. C. Thomas (1943).

In Galabin's case there was a ten weeks' ovum in the cul-de-sac. Following removal of the gestation the patient died of hemorrhage. In Witthauer's patient the tubes and ovaries appeared to be normal, but the omentum contained a blood clot in which chorionic villi were found. In Hirst and Knipe's case the ovum was implanted on the posterior aspect of the left broad ligament. The tubes and

ovaries appeared to be normal. Reifferscheid described a fetus 1.9 cm. in length which was completely preserved and found among the intestinal loops. The ovum was covered by blood clot; its torn and collapsed amniotic cavity, corresponding to the fetus which was discovered among the intestines, was empty and was found to be firmly attached to the underlying bed of the ovum through a very fresh chorion frondosum. Decidual changes were clearly observable in the peritoneal matrix. The primitive ovum rested in a depression in the peritoneum and had eroded into it; this was analogous to uterine nidation. Meticulous macroscopic and microscopic examination of the genital organs dispelled all doubt concerning their non-participation in the pregnancy. Studdiford's case of a primary peritoneal pregnancy, reported in 1942, is probably the most impressive and least open to doubt of any on record, and greatly strengthens the possibility that this type of primary ectopic nidation may take place. The site of implantation was the posterior aspect of the uterine horn, relatively close to the interstitial portion of the tube. Because of its relationship to the peritoneum and to the interstitial portion of the tube, Studdiford is of the opinion that the gestation reached this location by primary peritoneal nidation.

Novak (1947) previously skeptical of the existence of primary peritoneal pregnancy says of Studdiford's report: "The recent case of Studdiford, however, appears to qualify as a genuine instance of primary peritoneal implantation, in this case on the posterior surface of the uterus."

Studdiford gives three criteria to prove a primary peritoneal pregnancy: (1) Both tubes and ovaries must be normal with no evidence of recent or remote injury; (2) there must be no evidence of a uteroperitoneal fistula; (3) the pregnancy must be related exclusively to the peritoneal surface and young enough to eliminate the possibility of secondary implantation following a primary nidation in the tube.

Studdiford's case fulfilled the foregoing requirements. A specimen of it was presented before a meeting of the Society of Gynecological Pathologists of New York.

Thomas sees no reason why implantation in an endometrial deposit in the uterosacral ligament, peritoneum covering the rectum or sigmoid, or any part of the pelvic cavity for that matter, should not be accepted as the explanation of primary abdominal pregnancy. Gardner and Middlebrook believe that "primary abdominal pregnancy" describes any abdominal pregnancy in which evidences of origin from a primary intra-uterine or intratubal position are absent, and when the ovary is not definitely involved in the placental site.

In my opinion, primary abdominal gestation is likely to occur more often in cases of endometriosis. It is in these endometrial nests that the ovum finds a favorable nidus for its development. In two of my cases of abdominal pregnancy endometrial areas were present in the abdominal cavity. (Cases VII and IX.)

Curtis states that primary abdominal pregnancy may not be so rare as it was formerly thought to be; evidently the increased incidence of pelvic endometriosis has brought with it a corresponding increase in the incidence of primary pregnancy in the abdominal cavity.

Most abdominal gestations are secondary implantations. In these cases the placenta is drawn through the tubal perforation caused by rupture and continues its development on the peritoneal surface. Very infrequently these cases progress to term. If they approach or reach term, they are sometimes complicated by eclampsia, the symptoms of which are the same as those which occur during intra-uterine gestation. In these cases immediate abdominal delivery is indicated. (Figs. 36 to 44, Case IX.)

Some ectopic gestations present such mild symptoms at the time of rupture that the woman does not seek medical aid but makes a spontaneous recovery. Occasionally hyalinized villi (Figs. 17 and 18, Case V) observed in the tube at examination at a later date confirm the earlier existence of such a gestation.

Mummification and lithopedion formations are the result of unrecognized tubal ruptures which progressed to an advanced stage. In our experience twin ectopic pregnancies are infrequent. There was one case in this series in which the left tube contained two embryos in separate sacs.

*Cervical Gestation.* In this rare type of nidation the fertilized ovum traverses the uterine cavity and enters the cervical canal, instead of implanting in the upper portion of the uterus. (Fig. 14.) Although there is no reason to believe that the cervical mucosa possesses properties of resistance to the erosion and destruction of the trophoblast, this

mucosa is not especially well adapted to nourish the ovum.

Studdiford presents statistics from the literature for two groups of cases, each group containing fourteen cases. In the first group the occurrence of cervical pregnancy is substantiated by pathologic examination; in the second, by "more or less well defined" clinical evidence. He states that cervical implantation is very rare and presents serious problems which sometimes terminate fatally. He calls attention to the criteria for cervical pregnancy set up by I. C. Rubin in 1911, which are as follows: (1) There must be cervical glands opposite the placental attachment; (2) this attachment of placenta to cervix must be intimate; (3) the whole or a portion of the placenta must be situated either below the entrance of the uterine vessels or below the peritoneal reflection of the anterior and posterior surfaces of the uterus; (4) fetal elements must not be present in the corpus uteri.

*Combined extra-uterine and intra-uterine gestation* follows a serious clinical course. The uterine sac may abort before or after termination of the ectopic gestation. Or the ectopic gestation may be removed surgically, leaving the intra-uterine one to develop to term. If the ectopic fetus is not disturbed and develops to term, it may be delivered along with the intra-uterine child. The ectopic gestation seldom interferes with passage of the intra-uterine fetus (DeLee and Greenhill, 1943).

In these combined gestations intra-uterine pregnancy may take place in the presence of a dead ectopic fetus; a living ectopic gestation may precede or follow the uterine implantation; or there may be simultaneous intra-uterine and extra-uterine conception.

Since Novak (1926) reviewed 276 cases of combined intra-uterine and extra-uterine pregnancy, many additional cases have been reported in the literature.

An outstanding contribution to this subject was made by Samuel J. King, who subdivided coexisting intra-uterine and extra-uterine pregnancies into two groups: (1) combined or simultaneous and (2) compound.

*Combined Type.* As has already been mentioned in the historical section of this work, the first reported case of intra-uterine and extra-uterine pregnancy was that of Duverney in 1708. According to Novak (1926) combined pregnancy is a type of twin gestation.

*Compound Type.* This form is the superimposition of an intra-uterine pregnancy upon a pre-existing ectopic gestation.

Included in my series is the case already reported by Mayer and Berson, in which there was a coincidence of a lithopedion associated with a normal intra-uterine pregnancy and subsequent ruptured extra-uterine gestation. At the time of the tubal rupture the abdominal calcified pregnancy was discovered free in the abdominal cavity, adherent to the omentum. No evidence of a placenta could be found. The other tube was entirely normal.

*Changes in the Uterus during Ectopic Gestation.* Hyperemia and thickening of the endometrium result in an increase in the size of the uterus to that of a two to three months' intra-uterine gestation (Torpin, 1944). The organ assumes a slightly more globular shape and its consistency becomes softer (Kerr).

Regardless of the location of the gestation, the uterus responds by decidual reaction to the hormonal stimulation established by the pregnant state. Some little time elapses before a perfectly formed uterine decidua develops; hence, in the rare cases of ectopic gestation which terminate in the first few weeks a completely developed uterine decidua may not exist. As long as the ovum lives, uterine decidual reaction continues. When embryonic death takes place the uterine decidua degenerates and some days later is sloughed off, sometimes as a uterine cast but more often in shreds. This process is accompanied by uterine contractions. When a whole decidual cast or a large decidual shred is passed, either patient or physician, or both, may mistake the occurrence for an intra-uterine abortion. Coincidental with uterine decidual degeneration the patient notices hemorrhagic vaginal discharge, which is almost invariably of uterine origin, although it may be caused by other conditions, one of which is an active interstitial gestation (Novak, 1944). Occasionally before the ovum dies there is slight vaginal bleeding of tubal origin, probably caused, as Novak suggests, by "ovular unrest" at the implantation site.

If ectopic and early intra-uterine pregnancies are present simultaneously and if a diagnostic curettage is performed and chorionic villi are found, it is possible to overlook the ectopic component. In the later course of events the ectopic gestation is likely to become evident.

RECURRENT ECTOPIC GESTATION

There were three recurrent ectopic pregnancies in this series (1.73 per cent).

In ten series totaling 1,321 cases reported between 1939 and 1947, there were seventy cases of recurrence (5.3 per cent). The series represented were those of Atlee, Langman and Goldblatt, Lee, MacFarlane and Sparling, Marchetti et al., H. E. Miller, Nucci, Siegler, Ware and Winn (1946) and Woodhouse.

According to DeLee and Greenhill (1947) recurrent ectopic gestation occurs in about 4 per cent of cases of ectopic pregnancy.

A normal uterine pregnancy sometimes intervenes between two ectopic pregnancies. This occurred in seven of Urdan's twenty-seven cases of recurrent ectopic pregnancy.

Since etiologic factors responsible for ectopic pregnancy are frequently present in both tubes, it is not rare for the condition to occur in the remaining tube after the first tube has been excised. Occasionally the opposite tube, which was healthy at the time of the first ectopic pregnancy, may become diseased through infection resulting from laparotomy. Kerr reports a recurrent ectopic pregnancy in a tube which had been left *in situ* after conservative treatment for removal of the gestation.

Proponents of concomitant surgical procedures routinely correct incidental pelvic lesions in order to prevent ectopic gestation. In the series of sixty-five cases reported by Schauffler and Wynia, there was no instance in which a second ectopic pregnancy occurred; this was attributed to the fact that so many of their patients were sterilized.

*Second and final part of this article will appear in our April 1949 issue.*

# SURGICAL PROBLEMS OF RETAINED INTRATHORACIC FOREIGN BODIES

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DURING World War II considerable experience developed in the treatment of thoracic wounds. The able work of surgeons placed close to the front lines permitted many men who were wounded in the thorax to reach general hospitals. In the European Theater of Operations of the United States Army patients requiring thoracic operations were transferred to centers located in general hospitals. Harken[4] has discussed the work of such a center in England. The data upon which this paper is based regard 187 patients operated upon for thoracic foreign bodies following war wounds. Thirty-five of the missles had lodged in the parietes. One hundred sixty-five cases were found among 511 patients admitted to a thoracic center in England* and the remaining twenty-two were treated in a nearby hospital.

In any discussion of the late removal of intrathoracic foreign bodies there arises the question of the advisability of operation for asymptomatic missles. The general policy of surgeons working in field and evacuation hospitals was to remove large and readily accessible foreign bodies when thoracic wounds were débrided and closed. Thoracotomy was directly primarily to control of hemorrhage and closure of open wounds. There can be no question as to the desirability of removing foreign bodies lying close to important structures within the thorax. Furthermore, it is certainly wise to remove foreign bodies present when operations for clotted hemothorax and empyema are performed. Sommer and Mills[9] have shown that a large proportion of patients with empyema and infected hemothorax treated in this center had intrapleural foreign bodies.

*140th General Hospital.

Thomas[10] found a number of late complications among British veterans of World War I due to retained foreign bodies. The common symptoms, which arose ten to twenty years after injury, were hemoptysis, pain and purulent expectoration. The intrapulmonary missiles had caused bronchiectasis and lung abscess demanding operative treatment. Kay and Meade[7] mention two instances of gross hemoptysis caused by foreign bodies in the lung occurring six months and a year after injury.

CASE 1. A Luxemburg resident about 30 years of age was admitted to an American general hospital because of severe pulmonary infection. He had sustained severe penetrating wounds of the right thorax during 1943 while serving with the German army in the Crimea. An empyema which followed had been treated by a rather extensive open thoracoplasty during 1944. The patient when examined in August, 1945, was seen to be a well nourished white man with a severe productive cough and the general signs of infection. Pus was draining from a small sinus track in the center of the thoracoplasty scar. Roentgenograms demonstrated a marked pneumonitis about a good sized intrapulmonary metallic foreign body. Penicillin therapy which had been started was continued. The acute exacerbation subsided. New films (Fig. 1) showed a ragged foreign body lying in an abscess cavity at the level of the partially resected seventh and eighth ribs. The lateral film demonstrated the abscess to lie posteriorly and the smaller foreign body to be in the parietes. At operation with local anesthesia September 18th the sinus track was unroofed laterally and found to drain a small empyema pocket. The stumps of the seventh and eighth ribs were then resected. The smooth walled abscess cavity was opened and the foreign body removed. The empyema and abscess, which communicated with a good-sized bronchus, were packed.

Case 1 illustrates the formation of a chronic abscess about a retained foreign body coexistant with an independent empyema. The abscess had either been present from shortly after the primary injury or had developed rather earlier than those seen by Thomas.[10]

TABLE 1
RESULTS OF CULTURES FROM FOREIGN BODY SITES

| | Culture Positive | Culture Negative | Penicillin-Sensitive | Penicillin-Insensitive | Clostridia |
|---|---|---|---|---|---|
| Pulmonary | 23 | 22 | 7 | 1 | 7 |
| Pleural | 9 | 6 | 3 | 3 | 3 |
| Mediastinal | 5 | 2 | 1 | 1 | 1 |
| Subphrenic | 3 | 1 | 1 | .. | 1 |
| Parietal | 2 | 3 | 1 | .. | 1 |
| Total | 42 | 34 | 13 | 5 | 13 |

Harken[4] states that pathogenic microorganisms may be cultured from the sites of about 85 per cent of intrathoracic foreign bodies. Table 1 presents the data regarding cultures from foreign body sites in the cases under consideration. In this group cultures were planted from swabs rubbed in the foreign body sites of seventy-six cases. Cases in which infected hemothorax or empyema were present are not included in these figures regarding cultures which are from patients without pleural infection. Organisms were grown from forty-two (55.2 per cent). Penicillin-sensitive bacteria were found thirteen times in eighteen tested. Clostridial organisms were found thirteen times with nine instances of Clostridium Welchii. It is probable that a higher percentage of positive cultures could have been attained by placing the foreign bodies in culture media. The presence of pathogenic organisms at the site of asymptomatic foreign bodies furnishes a reason for their removal. A further reason for the removal of foreign bodies is the often unrecognized presence of clothing and rib fragments. In seven instances clothing was found with intra-

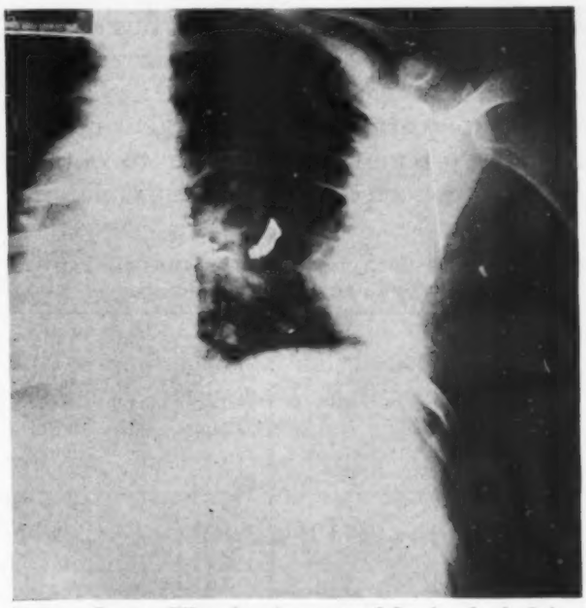


FIG. 1. Case 1. Film showing ragged foreign body lying in a pulmonary abscess.

pulmonary foreign bodies and in two with intrapleural foreign bodies. Rib fragments were associated with two each, intrapulmonary and intrapleural foreign bodies. These additional non-metallic elements form a distinct hazard and were factors in pleural infection (Sommer and Mills[9]).

In summary, the indications for removal of foreign bodies were essentially those stated by Harken.[4] Foreign bodies causing pain, hemoptysis or expectoration and asymptomatic foreign bodies 1 cm. or more in diameter in two dimensions were removed. Definite indications were afforded by proximity of foreign bodies to the heart, great vessels or esophagus. Any missiles present were removed during operations for clotted hemothorax and empyema.

Important considerations in the elective removal of intrathoracic foreign bodies are the associated mortality and morbidity rates. Holman[5] made the first American report in World War II of the removal of five foreign bodies without incident. In Table II are given data regarding foreign bodies removed from the thorax by a number of surgeons who were working in British and American thoracic centers some distance from the front. The patients treated were probably generally of the

same type as those discussed in this article. There were five deaths (0.9 per cent) in 565 cases.

Data regarding morbidity following foreign body removal are harder to obtain. Harken[4] reported two empyemas following more than 200 thoracotomies for foreign bodies. Table III lists the operations performed in the center for foreign bodies in various locations. One hundred thirty-one thoracotomies were carried out in the absence of pleural infection. These included twenty-one decortications for clotted hemothorax; two empyemas followed (1.5 per cent). One came after a decortication for clotted hemothorax with removal of an intrapleural foreign body. Two rib resections were necessary to cure the pocketed empyema. A second small empyema followed the removal of two intrapulmonary foreign bodies, the larger of which lay in a small abscess. A non-hemolytic Staphylococcus aureus sensitive to penicillin was grown from the abscess. Two intercostal drainage tubes were used for two days after operation; 360,000 units of penicillin were given intramuscularly in the first three postoperative days. A small empyema developed which was cured by two aspirations. On one occasion 30,000 units of penicillin were injected after aspiration. Friedländer's bacillus was cultured from the pus of the empyema.

In the early work of the center postoperative intercostal drainage was seldom used following thoracotomy for a foreign body. In thirty-two instances penicillin was placed in the pleural cavity prior to closure. The customary amount was 30,000 units although 40,000 and 100,000 units were used on a few occasions. No empyemas developed in this group. Intercostal drainage was used more frequently as the work progressed and always following decortication. Intramuscular penicillin administration was used only four times other than after decortication for empyema. Sulfonamide drugs were used on only two occasions. The two empyemas developed in drained cases. It was believed that good surgical technic and prompt expansion of the lung, however, were more important than antibiotic drugs in the prevention of postoperative pleural infections.

TABLE II
MORTALITY IN OPERATIONS FOR LATE REMOVAL OF INTRATHORACIC FOREIGN BODIES

| Authors | No. of Operations | Deaths | Mortality Rate (Per cent) |
|---|---|---|---|
| D'Abreu, Litchfield and Hudson[1] | 49 | 2 | 4.1 |
| Blades and Dugan[2] | 16 | 0 | |
| Harken[4] | 247 | 1 | .4 |
| Holman[5] | 5 | 0 | |
| Johnson[6] | 23 | 0 | |
| Kay and Meade[7] | 23 | 0 | |
| Tuttle, Langston and Crowley[12] | 44 | 0 | |
| Sommer and McColloch | 158* | 2 | 1.2 |
| | 565 | 5 | .9 |

* Figure excludes parietal foreign bodies with local removal.

TABLE III
TYPES OF OPERATIONS

| Operation | Location of Foreign Body | | | | |
|---|---|---|---|---|---|
| | Pulmonary | Pleural | Mediastinal | Subphrenic | Parietal |
| Thoracotomy | 58 | 12 | 19 | 4 | 3 |
| Limited thoracotomy | 4 | 8 | 1 | 1 | |
| Decortication for clotted hemothorax | 8 | 9 | .. | 1 | 3 |
| Empyema | | | | | |
| Open drainage | 3 | 7 | .. | 1 | |
| Decortication | 5 | 5 | | | |
| Limited rib resection and packing | .. | 2 | | | |
| Local excision | .. | .. | .. | 2 | 29 |
| Open drainage, subphrenic and liver abscess | .. | .. | .. | 2 | |
| Total | 78 | 43 | 20 | 11 | 35 |

One other serious complication occurred that has been discussed by Sommer and Mills.[9] A ragged foreign body was removed from the apical segment of the lower lobe of a patient at the time of decortication for a small clotted hemothorax. The foreign body lay adjacent to a good sized vein which was retracted during its exposure. A pulmonary abscess developed in the affected lung segment which regressed completely with penicillin and sulfadiazine therapy. Some days later convulsions occurred. Two exploratory operations at a neurosurgical center failed to locate the suspected brain abscess. When last seen, the patient was in a serious condition and further follow-up information is not available.

TABLE IV
TYPES OF MISSILES

| | Location of Foreign Body | | | | |
|---|---|---|---|---|---|
| | Pulmonary | Pleural | Mediastinal | Subphrenic | Parietal |
| Bullet | 7 | 2 | 7 | 1 | 5 |
| Shell fragment | 70 | 41 | 13 | 10 | 30 |
| Needle | 1 | | | | |
| Total | 78 | 43 | 20 | 11 | 35 |

Table IV presents the types of foreign bodies present in the patients who underwent operation. As is usual shell fragments were predominant. An ordinary straight pin was removed from the apical segment of the lower lobe of one patient who was unable to give any explanation as to how the pin had reached the pulmonary parenchyma. Two patients had double intrapulmonary missiles and two had foreign bodies in both the lung and pleura.

Prior to operation efforts were made to localize correctly foreign bodies. Posteroanterior and lateral roentgenograms were made in every case. Many patients were fluoroscoped. In certain cases fluoroscopic and roentgenographic studies of the esophagus with barium meal were very helpful in correct localization.

The operations performed are listed in Table III. The usual procedure was thoracotomy with posterolateral resection of a sufficient length of a rib to permit good exposure of the intrathoracic contents. The incision of Crafoord[3] was found to be very helpful for foreign bodies high in the chest. Whenever the position of the foreign body made use of an anterior approach advisable, intercostal incisions were used. Small incisions, termed limited thoracotomy, were used rather infrequently. Although this method was used with great success by Touroff[11] and others, the greater advantage seemed to lie with larger exposure. Twenty-one foreign bodies were removed at the time of decortication for clotted hemothorax. The foreign bodies associated with empyema were usually removed at the time of drainage or decortication, but in two cases second operations were necessary to remove the missiles. The great majority of parietal foreign bodies were removed through a small incision with local anesthesia.

It is generally recognized that thoracic surgery cannot succeed without well administered anesthesia. The work of the center was made possible by Major Lawrence J. Schuhmacher, Jr., M.C., chief of the anesthesia section, who developed a staff to carry on the duties of this section. Endotracheal ether anesthesia was used for all open thoracotomies. Furthermore, endotracheal anesthesia should be used whenever there is a possibility that a parietal foreign body may lie within the pleural cavity. On one occasion an attempt was made to remove an intrapleural foreign body with local anesthesia since it was thought to lie in the parietes. The operation was unsuccessful due to open pneumothorax. At a second operation with endotracheal anesthesia the foreign body was readily extracted. Local and intravenous anesthesia were used on a number of occasions.

Every effort was made prior to operation

to have the patients in good condition. Patients with empyema were operated upon promptly. Blood transfusions were used preoperatively whenever necessary to correct anemia. After one narrow escape from a tragedy an intravenous infusion was always begun during induction of anesthesia and blood was ready for transfusion if necessary.

The postoperative care was managed according to well known principles. Adequate fluid intake was maintained. Although provision for oxygen therapy was constantly available, it was used only rarely. Atelectasis occurred several times and was treated with bronchial catheter suction and bronchoscopy. The arrangement of the center permitted the grouping of postoperative and seriously ill patients on one ward. Continuity of nursing personnel insured efficient care.

Any discussion of thoracic injuries and operations should include rehabilitation. Early postoperative ambulation is an important factor. The patients were customarily out of bed within forty-eight hours. Voluntary respiratory exercises were begun on admission to the center and continued after operation. These exercises restored normal function of the injured and operated sides of the thorax. The patients were very cooperative in their efforts to gain unilateral control of respiration. The art of voluntary respiratory exercises has been well described by Miss Reed[8] and Harken[4] has emphasized their importance. Only a few of these patients were returned to duty in the theater due to evacuation policies. They did return to the United States, however, as walking patients with every prospect of living normal lives. Under other circumstances more men could readily have been used in the theater.

### PULMONARY FOREIGN BODIES

The largest single group of foreign bodies were those within the lung. Table III shows that of the seventy-eight pulmonary foreign bodies fifty-eight were operated upon by the usual thoracotomy and four by limited thoracotomy. Decortication for clotted hemothorax was done in eight cases and in five for empyema along with foreign body removal. In three cases simple open drainage of empyemas was performed and the foreign bodies removed from the lungs. In one of these the foreign body was removed by a rib resection at a second operation. At the first operation for drainage the foreign body was not accessible and the patient was too ill for a prolonged procedure. In one case a prolonged search failed to locate a foreign body in the right hilar region. No deaths occurred. The complications were one embolism and one empyema. One patient was not operated upon for a large foreign body close to the arch of the aorta. The patient was admitted with a satisfactorily drained empyema which healed. He had had, however, three previous operations. A blood culture had been positive for Staphylococcus albus. Cerebral embolism had apparently occurred. The patient was in poor physical condition, was deaf and almost blind as the result of injury and disease.

Case II. A twenty-one year old corporal sustained penetrating shell fragment wounds of the left thorax and shoulder April 6, 1945. The wounds were débrided and a plaster spica dressing was applied for the badly fractured left humerus on April 7th. Penicillin was given in an unknown amount. On April 21st secondary closures of the wounds of the arm and thorax were performed. Penicillin (520,000 units) was given intramuscularly during the following days. The patient was admitted April 30th. The left arm was in a hanging plaster dressing. An unhealed wound was present on the left shoulder. Roentgenograms (Fig. 2) demonstrated a large foreign body in the left lung posteriorly. On May 17th the left pleural cavity was opened after resection of the fifth rib. A ragged foreign body measuring 3.5 by 2.5 by 2 cm. was removed from the apex of the lower lobe. The opening in the lung was closed with a fine catgut suture. After irrigation of the pleural cavity with saline solution the thoracic wall was closed

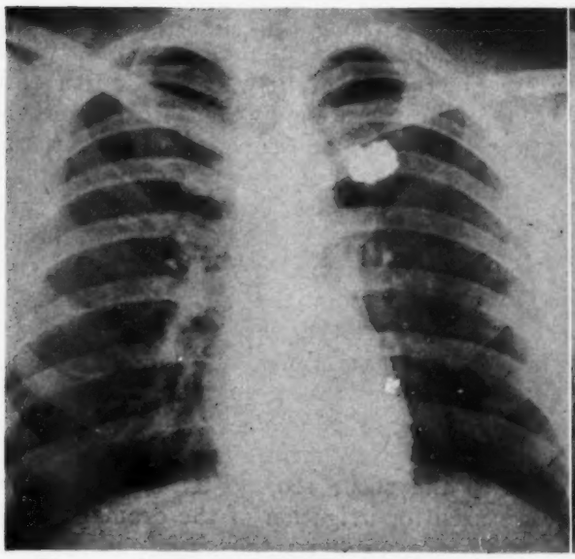


FIG. 2. Case II. Anteroposterior film showing large intrapulmonary foreign body.

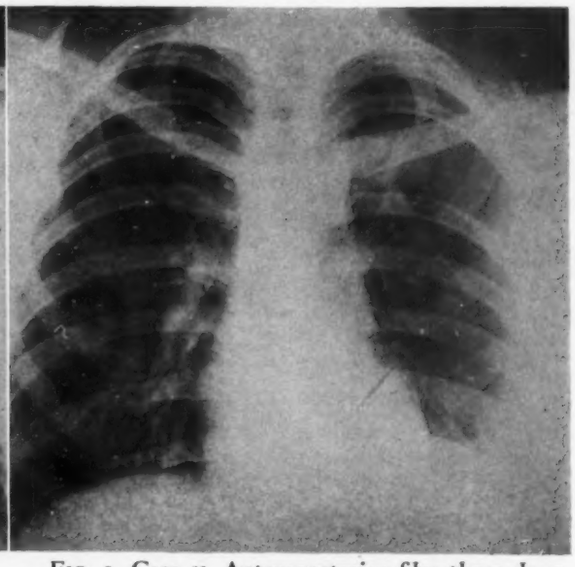


FIG. 3. Case II. Anteroposterior film three days following removal of foreign body from lung.

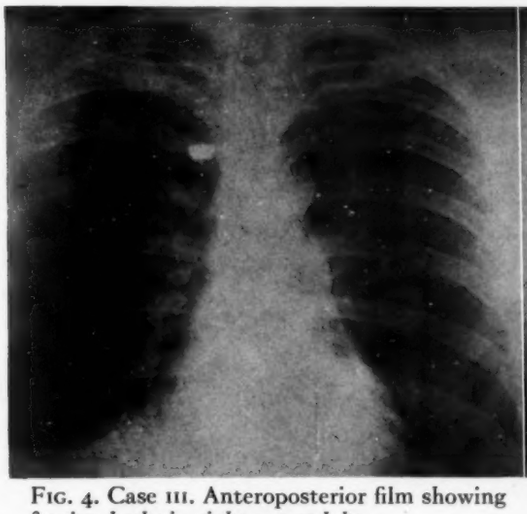


FIG. 4. Case III. Anteroposterior film showing foreign body in right upper lobe.

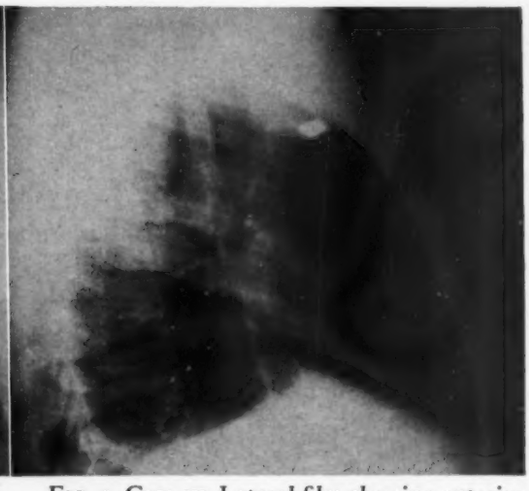


FIG. 5. Case III. Lateral film showing anterior position of foreign body.

with interrupted sutures. Clostridium Welchii and tetani and coagulase and mannite positive Staph. aureus were cultured from the foreign body site. The Cl. Welchii was sensitive to penicillin. The patient made an uneventful recovery from the operation. Fluid was aspirated from the pleural cavity on several occasions. Roentgenograms (Fig. 3) showed complete re-expansion of the lung on May 20th. The soldier was transferred to the United States as ambulatory on June 1st.

CASE III. A twenty-six year old soldier sustained a penetrating shell fragment wound of the right axilla February 10, 1945. The wound was débrided the same day. Penicillin (1,000,000 units) was given intramuscularly February 10th to the 15th; 500 cc. of fluid were aspirated from the right pleural cavity February 13th and 40,000 units of penicillin were injected. He was admitted March 4th. Roentgenograms on March 5th (Figs. 4 and 5) demonstrated a rectangular foreign body lying anteriorly in the upper lobe of the right lung. On March 13th a thoracotomy was performed with an anterior incision through the second interspace. The internal mammary vessels were doubly ligated and divided. The loosely adherent lung was freed and the foreign body removed from the lung beneath the first interspace. The thoracic wall was then closed in layers with interrupted sutures after the pulmonary wound had been closed with a fine

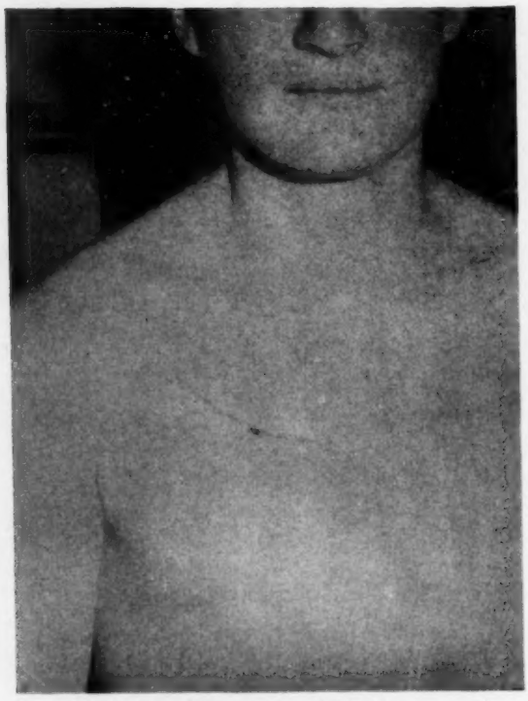


FIG. 6. Case III. The patient following operation.

catgut suture. The patient (Fig. 6) made an uneventful recovery. He was transferred to the United States April 13th as ambulatory.

CASE IV. A twenty-one year old soldier sustained a perforating shell fragment wound of the left arm with a severe compound fracture of the humerus and a penetrating wound of the left thorax March 4, 1945. On this same day the arm wound was débrided and the humerus fixed with a plaster dressing; thoracotomy was performed through the bed of the resected seventh rib. Penicillin (860,000 units) was given intramuscularly from March 4th to the 11th; 700,000 units March 16th to 22nd and 720,000 units from April 9th to the 15th. The arm wound was dressed several times. On five occasions 20 to 400 cc. of fluid were aspirated from the left pleural cavity. The patient was admitted on May 2nd. Roentgenograms (Figs. 7 and 8) demonstrated a left pleural effusion with a large air pocket superiorly; the heart was drawn to the left and a large foreign body lay apparently in the lower lobe. Pus, 50 cc., and some air were aspirated May 15th. Cl. Welchii and a mannite and coagulase positive hemolytic Staph. aureus, which was sensitive to penicillin, grew from the pus. On May 21st a left thoracotomy was performed with further resection of the seventh rib. The lung was compressed against the mediastinum and the pleural cavity was filled with pus and large necrotic clots. The pulmonary lobes, which were greatly distorted, were freed with difficulty from the tough fibrous scar over the visceral pleura. The dissection to liberate the lung was carried out in part within the plain of the visceral pleura, but the lung was completely mobilized. The flat, metallic, foreign body, which measured 2.5 by 1.8 by 0.3 cm., was removed from the lower lobe. It was covered with cloth. The pleural cavity was drained with anterior, lateral and posterior intercostal tubes with water seals. The thoracic wall was closed in layers. Penicillin (960,000 units) was given intramuscularly from May 21st to the 26th; 160,000 units of penicillin were used for irrigation of the drainage tubes which were removed the 25th and 26th of May. The patient made a very satisfactory recovery with primary healing of the empyema. Roentgenographic examination on June 5th (Fig. 9) demonstrated the lung to be fully expanded. The patient (Fig. 10) was transferred to the United States in an ambulatory status on July 18th.

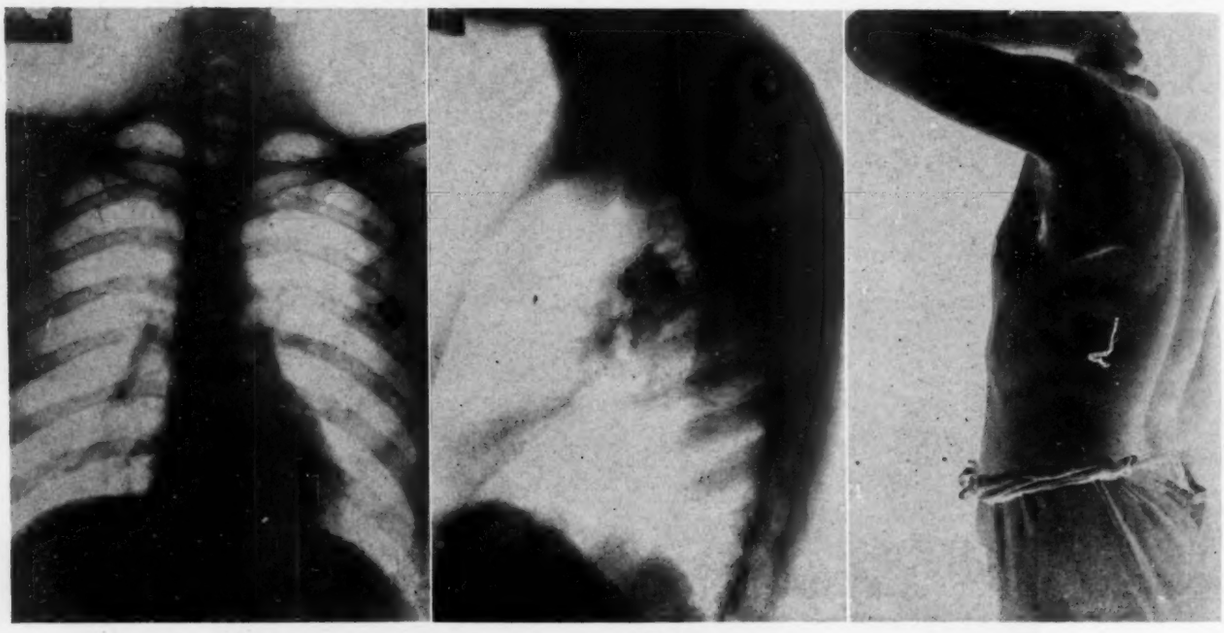
Cases II, III and IV illustrate the principal problems and methods of removal of foreign bodies in the lung in the center. In Case II the usual thoracotomy was performed while limited thoracotomy was used in Case III. Thoracotomy with decortication of the lung with removal of the intrapulmonary foreign body was certainly the proper procedure in Case IV in the presence of empyema with a markedly compressed and distorted lung.

In two instances pulmonary abscesses were present about foreign bodies. The course of one case, which was complicated by the only empyema following removal of an intrapulmonary foreign body, has been described. The second abscess presented an interesting problem.

CASE V. A twenty-four year old soldier sustained a perforating shell fragment wound of the left arm and a penetrating wound of the left thorax, with fracture of the third rib on March 13, 1945. A severe compound fracture of the right femur was caused by another fragment. The wounds were débrided the same day and a plaster spica dressing applied to fix the

FIG. 7 Case IV. Postero-anterior film showing empyema with fluid level and heart displaced to left with large foreign body.
FIG. 8. Case IV. Lateral film of empyema and intrapulmonary foreign body.
FIG. 9. Case IV. Postero-anterior film fifteen days following decortication for empyema and removal of foreign body from lung.
FIG. 10. Case IV. The patient fifteen days following decortication and removal of foreign body.

right leg. Penicillin (2,300,000 units) was given intramuscularly from March 13th to April 3rd. Severe hemoptyses occurred from April 1st to the 3rd. The patient was admitted April 3rd with continuing hemoptysis. The right leg was in a Thomas splint. The most satisfactory roentgenogram of the thorax had been taken in bed in an oblique projection. It showed the large foreign body lying posteriorly in a large upper lobe abscess cavity. Prompt operation was advisable to prevent recurrent hemoptysis. On April 4th the patient was carefully placed upon the right side after induction of anesthesia and passage of an endotracheal tube. The left pleura was opened with resection of a long length of the fifth rib. The lung was densely adherent beneath this rib to the pleura which had been opened carefully posteriorly. Pus, which



11 12 13

FIG. 11. Case VI. Postero-anterior film showing foreign body in left pleural cavity.
FIG. 12. Case VI. Lateral film showing foreign body with marked adjacent pulmonary reaction.
FIG. 13. Case VI. Patient forty-two days after operation; the posterior wound of entry and axillary wound of foreign body removal are seen.

was seen coming from a small opening in the lung, was quickly aspirated. The opening was enlarged and a large ragged foreign body and considerable pus were removed from the abscess. The lung was closed with a fine catgut suture. The lung was adherent below the fifth rib but was free above it. An intercostal drainage tube with water seal was inserted through the third interspace posteriorly. Gloves and instruments were changed before closure of the thoracic wall in layers. The convalescence was uneventful. The drainage tube was removed with the lung fully expanded on the third postoperative day. Penicillin was not given. A penicillin-sensitive Cl. Welchii and Streptococcus viridans were grown in cultures from the pus. The patient was sent to the United States after further appropriate treatment for the fractured femur.

It probably can be correctly argued that the patient in Case V should have been treated with resection of a short length of rib and packing of the pulmonary abscess. It does show that this type of abscess may heal with removal of the offending foreign body. Furthermore slight soiling of the pleura did not cause empyema with prompt re-expansion of the lung.

### INTRAPLEURAL FOREIGN BODIES

The second largest group of foreign bodies are those lying intrapleurally. Of the forty-three intrapleural foreign bodies twelve (27.9 per cent) were associated with empyema. Limited thoracotomy was employed relatively more frequently for intrapleural than for intrapulmonary foreign bodies. (Table III.) Twelve routine thoracotomies were performed and eight limited. One advantage of the larger operation was demonstrated by the unexpected discovery of omentum herniated through a lacerated diaphragm; this discovery would not have been made with the use of a small incision directly over the foreign body. The ample incision permitted ready repair of the hernia. Decortication for clotted hemothorax and empyema were performed eight and nine times, respectively, along with foreign body removal from the pleura. In four cases empyemas were drained and foreign bodies removed. In one case a second operation was performed thirteen days after drainage of an empyema and a large foreign body inaccessible at the drainage procedure removed; the wound was

closed and healed primarily. In two cases foreign bodies were removed and the wounds packed lightly and permitted to close by granulation. There were no deaths in this group and one postoperative empyema.

CASE VI. A soldier sustained a penetrating shell fragment wound of the left thorax posteriorly March 20, 1945. The same day the wound was débrided. Penicillin (180,000 units) was administered intramuscularly from March 20th to the 23rd. The soldier was admitted on April 6th. Roentgenograms (Figs. 11, 12) demonstrated a flat, metallic foreign body lying in the periphery of the left thorax, with considerable surrounding soft tissue reaction. On April 10th with endotracheal anesthesia a curved axillary incision was made. The fractured fourth rib was resected subperiosteally. A number of loose bone fragments were removed from the pleura and surrounding lung. After removal of the foreign body which lay on the lung a good sized bronchial fistula was seen. The wound was lightly packed. Prompt healing of the wound and fistula took place. The patient (Fig. 13) returned to the United States on May 23rd. No organisms were demonstrated from the foreign body site by smear or culture.

### MEDIASTINAL FOREIGN BODIES

A very interesting group of foreign bodies are those in the mediastinum. In all, twenty-three were seen. In three instances operation was not performed. In two of these the foreign bodies lay behind the sternum; operation was deferred because of nearby granulating wounds following the resection of infected cartilages and ribs. In a third case a mediastinal foreign body was accompanied by an infected hemothorax which was fortunately cured by aspiration and penicillin therapy. The planned thoracotomy was given up because of two severe bouts of thrombophlebitis. In the first attack the vena cava and right femoral veins were involved and in the second the left subclavian. It did not seem wise to operate upon a patient with such a recent history. Twenty thoracotomies were performed, one of which was limited. One postoperative death occurred and no empyemas.

FIG. 14. Case VII. Anterioposterior film showing bullet in right ventricle.

The mediastinal foreign bodies are associated with important structures. Seven lay on or were embedded in the pericardium; all were removed without difficulty. There were five cardiac foreign bodies, four within the chambers and one deep in the muscle of the left ventricle. All were operated upon and three removed. In one case the foreign body in the right ventricle was not adequately exposed through an anterior incision and was left untouched. In a second case the foreign body in the left auricle could not be felt and it was thought best not to open the auricle. A very interesting symptom in a patient with a shell fragment lying on the diaphragmatic aspect of the right ventricle was severe pain referred to the left shoulder entirely relieved by removal of the foreign body.

CASE VII. A twenty-two year old soldier sustained a compound fracture of the right humerus and a penetrating bullet wound of the right thorax March 30, 1945. The wounds

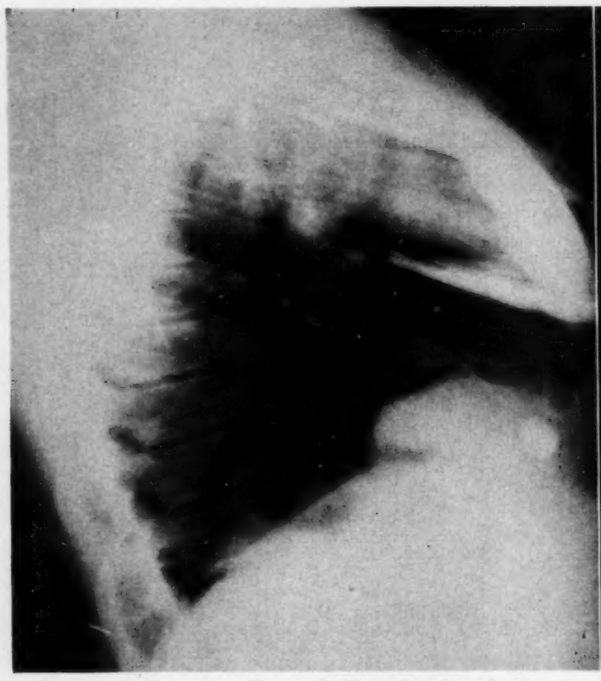


FIG. 15. Case VII. Lateral film showing bullet in right ventricle with haziness due to cardiac movement.

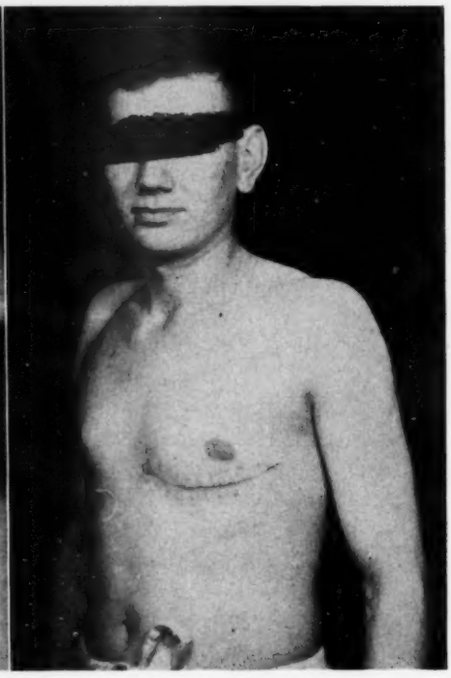


FIG. 16. Case VII. The patient twenty-two days after removal of bullet from right ventricle.

were promptly débrided and the fracture was immobilized with a plaster spica dressing. Penicillin (720,000 units) was given intramuscularly from March 30th to April 3rd. The wounds were closed secondarily April 10th with re-application of the plaster spica dressing. The patient was admitted April 23rd. Roentgenograms (Figs. 14, 15) demonstrated the bullet lying in the right ventricle above the diaphragm. The movement of the foreign body is seen well in the lateral projection. Electrocardiagrams showed evidence of right myocardial damage. It seemed likely that the bullet had reached the ventricle through the blood stream. On April 30th the left pleural cavity was opened by an incision through the fifth anterior interspace. The internal mammary vessels were doubly ligated before division. The fifth and sixth costal cartilages were divided. The pericardium was opened. The bullet could be palpated lying against the diaphragmatic portion of the right ventricular wall. Two silk stay sutures were placed anterior to the bullet but only one could be placed posteriorly because of the proximity of the right coronary vessels. An incision was made with a knife parallel to the adjacent vessels. The bullet was reached, grasped with a curved hemostat and withdrawn. The stay sutures, which had been held by an assistant, were crossed. Only a few cc. of blood were lost probably due to endocardial clots. Interrupted silk sutures were employed to close the myocardial incision. A free graft of pericardium was fixed over the incision by tying the stay sutures to each other. The pericardium was closed with fine silk sutures leaving an opening for drainage. The thoracic wall was closed without drainage. The postoperative course was without event. Sanguineous fluid was aspirated from the pleural cavity on three occasions. The patient (Fig. 16) was ambulatory and returned to the United States on May 27th.

The remaining eight mediastinal foreign bodies were closely associated with the esophagus and great vessels. In two instances operations were unsuccessful in removing foreign bodies. In one case the well encapsulated shell fragment lay on the vertebrae. The incision had not been well placed. This fragment was removed after return of the patient to the United States. In a second case a bullet was approached through the left pleural cavity. It was found lying to the right of an

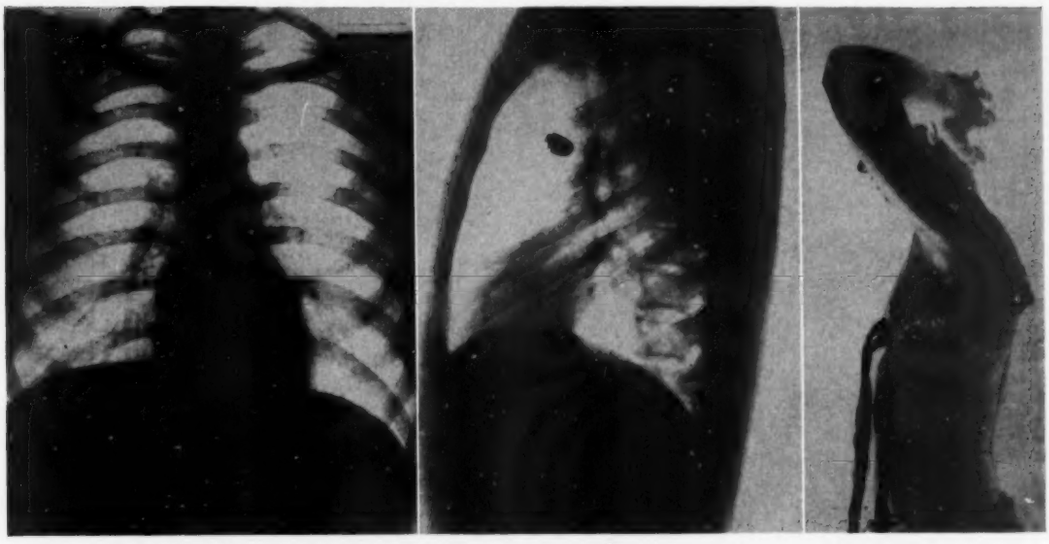


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FIG. 17. Case VIII. Postero-anterior film showing bullet in mediastinum.
FIG. 18. Case VIII. Lateral film showing bullet lying in anterior mediastinum.
FIG. 19. Case VIII. The patient five days after removal of bullet from mediastinum.

aneurysmal dilatation of the aorta. Dissection over the damaged aorta did not seem wise.

CASE VIII. An eighteen year old soldier sustained a penetrating bullet wound of the right thorax on April 8, 1945. The wound was débrided that day; 260,000 units of penicillin were given intramuscularly from April 8th to the 10th. He was admitted April 27th. Roentgenograms (Figs. 17, 18) showed the bullet lying in the superior mediastinum. On May 15th a left posterolateral transpleural approach was employed to remove the bullet. The Crafoord[3] incision, (Fig. 19) which was found so useful with foreign bodies located high within the thorax, was used to permit ready resection of the fifth rib. The bullet was removed from a pocket containing brown fluid anterior to the aorta after opening of the mediastinal pleura which was not closed. Penicillin, 100,000 units, in 100 cc. of saline solution were placed in the pleural cavity before closure of the thoracic wall without drainage. No organisms were seen in smears from the foreign body site. The patient, who was seen five days after operation returned to the United States on June 1st. (Fig. 19.)

CASE IX. A thirty-one year old soldier sustained a penetrating shell fragment wound of the upper anterior right thorax February 24, 1945. The wound was débrided the following day. 300,000 units of penicillin were given intramuscularly from February 25th to the 27th. Rather marked edema of the left cervical region and arm was present from March 2nd to March 6th, with a temperature elevation to 103°F. During this period 1,040,000 units of penicillin were administered. The patient was admitted on March 19th. He presented the general signs of infection with an elevated white blood count. Roentgenograms (Figs. 20, 21) showed a widening of the upper anterior mediastinum with a shell fragment lying posteriorly in the mediastinal shadow. A diagnosis of mediastinal abscess was made. On March 22nd a transverse cervical incision was made; exploration of the superior mediastinum failed to disclose an abscess. The left pleural cavity was entered through an anterior incision. A dense mass was found above the aortic arch bulging to the left. A thrill was noted. In attempting to dissect into the mass an opening was made into a false aneurysm. The tremendous hemorrhage was controlled with a finger. The sternum was transected to afford better exposure and a second opening was made into the aneurysm. The two openings were closed with silk sutures after removal of the shell fragment. The sternum was wired and the thoracic wall closed. During the operation 1,500 cc. of blood and 7 units of plasma were given. The patient died some hours later with an ascending temperature probably due to cerebral hypoxia during the operation. Postmortem examination disclosed a huge false

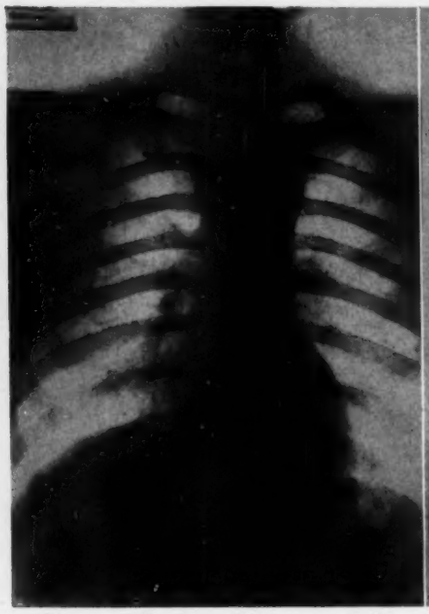

FIG. 20. Case IX. Postero-anterior film showing false aneurysm with shell fragment in upper mediastinum.

FIG. 21. Case IX. Lateral film of false aneurysm of anterior mediastinum with shell fragment.

aneurysm surrounding the great vessels and intimately associated with the arch of the aorta. The mediastinal pleura had apparently afforded substance to form the wall of the aneurysm. Close to the aorta there was a linear opening in the wall of the left subclavian artery which was the site of an extensive thrombus.

In Case IX the significance of the edema of the left arm had not been appreciated and a correct diagnosis had not been made. It is hard to see, however, how the condition could have been corrected since proximal control of the vessels could not have been obtained.

### SUBPHRENIC FOREIGN BODIES

There were eleven subphrenic foreign bodies removed. Seven were removed transdiaphragmatically, four by thoracotomy, one each by limited thoracotomy at decortication and at combined drainage of an empyema and subphrenic abscess. Two small intercostal incisions sufficed to remove foreign bodies below the diaphragm. One was removed at the time of drainage of a liver abscess and another from a patient with a subphrenic abscess. No postoperative empyema occurred and one patient died. The patient who died was admitted with a subphrenic abscess which was drained widely with rib resection. The large foreign body which lay lateral to the vertebral bodies could not be reached. Severe hemorrhages occurred thought to be coming from a stump of the splenic artery near the foreign body which was then removed through an abdominal incision. The left kidney was later removed when recurrent hemorrhage led to the correct diagnosis of wound of the renal artery. The patient died of peritonitis after several severe hemorrhages due to infection.

CASE X. A twenty year old sergeant sustained a penetrating shell fragment wound of the right thorax below the tip of the scapula January 13, 1945. The wound was débrided the same day. 500,000 units of penicillin was given intramuscularly from January 13th to the 16th. Sanguineous fluid, 2500 cc., was aspirated from the right pleural cavity in four sittings, the last January 27th. The patient was admitted February 12th. Roentgenograms (Fig. 22) showed the foreign body lying beneath the heart. On February 15th the left pleural cavity was opened through an anterior intercostal incision. The pericardium was opened

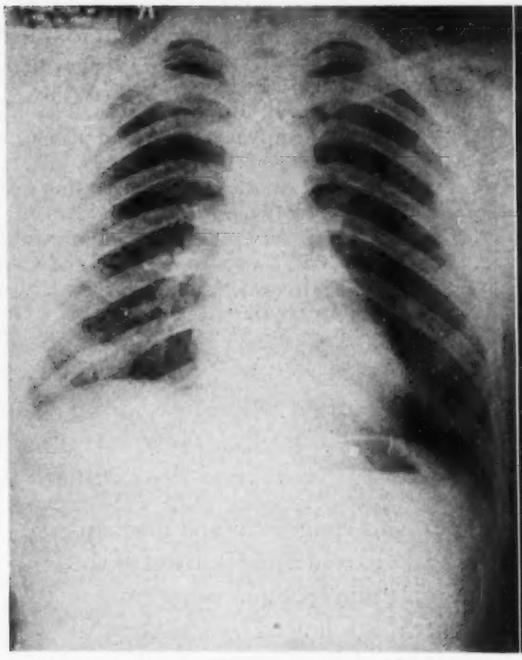

FIG. 22. Case x. Postero-anterior film showing foreign body below cardiac shadow and diaphragm.

FIG. 23. Case x. The patient following removal of subphrenic foreign body.

and the shell fragment felt beneath it. The diaphragm was then split and dissection carried forward beneath the pericardium until the fragment was reached and removed. The diaphragm was closed with fine silk sutures and the pericardium was loosely approximated in the same manner. The thoracic wall was closed without drainage. Cl. pseudodiphthericum was cultured from the foreign body site. The patient (Fig. 23) made an uneventful recovery and returned to the United States in an ambulatory status March 9th.

### PARIETAL FOREIGN BODIES

There were thirty-five foreign bodies removed from the thoracic wall. Three were removed by thoracotomy and three at the time of decortication for clotted hemothorax. Twenty-nine were removed through suitably placed soft part incisions. Parietal foreign bodies may present difficult problems of localization and removal. It cannot be emphasized too much that certain suspected parietal foreign bodies should be removed with endotracheal anesthesia in order to avoid re-operations and uncontrolled open pneumothorax. There were no complications of note following operations on those in this group.

### SUMMARY

A report has been made regarding the operative treatment of 187 patients with foreign bodies lodged in the chest. Of these 162 were within the thorax and thirty-five were in the parietes. The experience with these cases and data from the literature indicate that intrathoracic foreign bodies adjacent to important structures should be removed along with any causing symptoms. Elective removal of foreign bodies larger than 1 cm. in two or more directions is advised. The operative removal of intrathoracic foreign bodies is attended by low mortality and morbidity rates.

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In cases of pulmonary arteriovenous aneurysms congenital and mechanical defects are present between the arteries and veins in some portion of the lung field. Medical therapy is of no avail but lobectomy, or any other similar procedure which removes the involved lung area, is followed by a successful result in almost all cases. W. L. Watson reports two successful cases. In one a lobectomy was done; in the other he found, doubly ligated and severed, an aberrant artery springing from the thoracic aorta. With elimination of this artery, the lung disorder seemed to disappear. At any rate no mass was palpable, hence, no lung tissue resection was done. The patient did well. We are certainly making great strides in the fields of thoracic and vascular surgery. (*Richard A. Leonardo, M.D.*)

# PERFORATED GASTRIC AND DUODENAL ULCERS*

## AN ANALYSIS OF 200 CONSECUTIVE CASES

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ACUTE perforation of a gastric or duodenal ulcer is a frequent surgical emergency. In the more common diseases it is wise to review periodically the etiologic factors, methods of diagnosis and results of therapy and in view of such knowledge plan for the future. This report is an analysis of 200 consecutive cases of perforated ulcers of the stomach and duodenum seen at the University Hospital, Baltimore, from 1935 to 1946. These data include private patients as well as free patients and patients operated upon by senior surgical house officers and members of the visiting surgical staff. The patients came from every strata of society and are typical of the group of patients seen in a general hospital.

The history of this problem is quite interesting in that many of our present day problems were encountered shortly after surgery was first attempted in the treatment of perforation. One of the earliest accounts[13] of a perforated ulcer was made in 1670. A member of the royal family of France had a gastric ulcer which was proven by postmortem examination. Hamburger[16] in 1747 reported the first diagnosed case of perforated duodenal ulcer which was also proved by postmortem examination. O'Hara[15] in 1875, at a Philadelphia pathologic meeting, reported the first case in the United States. Mikulicz[14] first operated upon a perforated peptic ulcer in 1880, but the patient died in shock three hours later. Mikulicz did not report this case until 1897. The first successful operation was performed by Heussner[11] in 1892 with a simple closure by suture. Weir[19] had the first successful operation for perforation in the United States in 1896. In 1892 Hall[9] reported six cases of patients who underwent spontaneous cures of the perforation without surgery. Braun[4] in 1897 advocated the use of gastro-enterostomy with closure of the ulcer; in 1909 Dowden[7] advocated a longitudinal excision of the ulcer with a transverse suture of the excised area and finally in 1919 Von Haberer[18] advised gastric resection in perforated ulcer.

### ETIOLOGIC FACTORS

*Sex and Age of the Patient.* In this series of cases there were 93.5 per cent males with perforated ulcer and 6.5 per cent females (Table 1) which corresponds with the reports of the majority of writers but is not as great a division as that of DeBakey[6] with 98.1 per cent and Davison[5] with 98 per cent males. There were no patients in the childhood group, the youngest being nineteen years of age and the oldest seventy-six years of age. Fifty-one and fifty-four patients were seen in the fourth and fifth decades, respectively, with perforated ulcer of the stomach or duodenum. Only 14 per cent of the patients were seen in the first three decades which is decidedly less than that in DeBakey's series of 25 per cent but more than the 8 per cent reported by Black and Blackford[2] at the Mayo Clinic. The relationship of age to mortality corresponds with that reported by Raw,[17] DeBakey and Black and Blackford, in that the mortality rate rises steadily as older patients come to this type of surgery. Raw reports a 7.6 per cent mortality rate in patients under forty-two, DeBakey reports 18.9 per cent mortality in the fourth decade and in this series the hospital mortality rate is 14.8 per cent for

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patients under thirty years, 13.4 per cent for those between thirty and forty years and 36.5 per cent for all patients over the age of forty. However, twelve patients of this series were not operated upon so the mortality per age group for those operated upon is 14.8 per cent for those under thirty, 11.5 per cent for those between thirty and forty and 18.8 per cent for those over the age of forty.

TABLE I

| | No. Patients | Patients (Per cent) |
|---|---|---|
| Sex | | |
| Males | 187 | 93.5 |
| Females | 13 | 6.5 |
| Race | | |
| White | 172 | 86.0 |
| Negroes | 28 | 14.0 |
| Others | 0 | 0 |
| Age | | |
| 0–9 | 0 | 0 |
| 10–19 | 1 | 0.5 |
| 20–29 | 27 | 13.5 |
| 30–39 | 51 | 25.5 |
| 40–49 | 54 | 27.0 |
| 50–59 | 44 | 22.0 |
| 60–69 | 16 | 8.0 |
| 70–79 | 7 | 3.5 |
| over 80 | 0 | 0 |

TABLE II

| | No. Patients | Patients (Per cent) |
|---|---|---|
| January | 12 | 6.0 |
| February | 12 | 6.0 |
| March | 19 | 9.5 |
| April | 16 | 8.0 |
| May | 19 | 9.5 |
| June | 26 | 13.0 |
| July | 11 | 5.5 |
| August | 8 | 4.0 |
| September | 25 | 12.5 |
| October | 25 | 12.5 |
| November | 10 | 5.0 |
| December | 17 | 8.5 |
| Spring | 54 | 27.0 |
| Summer | 45 | 22.5 |
| Autumn | 60 | 30.0 |
| Winter | 41 | 20.5 |

*Race.* The racial relationship cannot be definitely determined from this small series in which only twenty-eight negroes were seen over a twelve-year period. (Table I.) This is probably due to the fact that relatively few beds are available for negroes in this hospital. DeBakey reports a racial incidence per 100,000 admission as being 40.4 white and 36.4 negroes, thus revealing that acute perforations of gastric and duodenal ulcers occur about evenly in the two races.

TABLE III

| | No. Patients | Patients (Per cent) |
|---|---|---|
| Hard labor | 124 | 62.0 |
| Professional | 7 | 3.5 |
| Sedentary (white collar) | 48 | 24.0 |
| No occupation | 21 | 10.5 |

*Season and Occupation.* There was no sharp demarcation in the seasonal incidence of this disease (Table II) which is contradictory to many early teachings and textbooks on surgery and medicine. The great majority of the patients (Table III) were classified as doing hard labor (corresponding well with the general population average). The absence in this series of the high-strung, nervous individual, who is so often characterized as the "ulcer type" as seen in the professional and sedentary (white collar) person, was interesting and again in contradistinction to earlier reports. These findings agree well with those of Anderson, Allen and Packard[1] in which they deny any seasonal or occupational relationship to the problem. Many series report the greatest incidence of perforation of gastric and duodenal ulcers occurring in the laboring class. Walton[20] reports 50 per cent, Fallis[8] reports 63 per cent, Zukschwerdt and Eck[21] report 69 per cent and Lang[12] reports 75 per cent of their patients with perforated gastric and duodenal ulcers to be in the laboring class.

*History.* Eighty-nine per cent of the patients had a history of gastric dis-

turbances, ranging from a mild feeling of fullness and discomfort after meals to a typical history of hunger pains, tarry stools and/or relief of pain with alkali. Thirty per cent of the patients had a positive history of use of alcohol during the episodes of gastric disturbance or just prior (a few days to two or three weeks) to the perforation. Sixteen per cent of the patients had just had a recent meal or had been drinking an alcoholic beverage within a few hours of the perforation. However, 11 per cent had the perforation occur without any history of gastric disturbances suggestive of the presence of a gastric or duodenal ulcer which is much lower than the 25 per cent reported by Bockus.[3] There was no history of trauma externally or internally such as a perforation occurring during a roentgenologic examination with barium meal. Interestingly enough, however, Fallis,[8] in an analysis of one hundred cases of perforated peptic ulcer at Henry Ford Hospital, reported a 4 per cent incidence of trauma related to perforation of the ulcer. Two of his patients had perforation occur immediately following external abdominal injury and two instances of perforation occurred during fluoroscopic examination of the stomach after ingestion of a barium meal.

## DIAGNOSIS

The correct diagnosis of this catastrophe was made in 95.5 per cent of the cases. The usual diagnostic points mentioned in the records were a fairly definite history suggestive of a gastric or duodenal ulcer, with an exaggeration of symptoms for a day or two prior to perforation, sudden, sharp, knife-like epigastric pain, nausea and prostration. Confirming reports of some observers, vomiting was not seen as a constant finding as is stated by many standard surgical texts. In this case it was present in 45 per cent of the patients and then in the majority of instances the patient only vomited once and seldom more than two times. Hematemesis was an unusual finding, occurring in only 7.5 per cent of the patients.

Examination usually revealed board-like rigidity of the abdomen, with extreme abdominal tenderness and muscle spasm, facies of agony and a reluctance to a change of position on the examining table. Early after perforation these signs were most marked in the upper abdomen but within a few hours usually the signs were those of diffuse peritonitis. The temperature and pulse rate were low but as peritonitis spread these tended to rise. Right lower quadrant pain, tenderness and rigidity were seen frequently when the spread of escaped fluid was down the right colic gutter. It was in this group of patients that the errors in diagnoses were made as acute appendicitis. If the patients were seen several hours after perforation, the signs were those of diffuse peritonitis but the diagnosis could usually be made on the history alone. Auscultation would reveal the characteristic quiet abdomen of peritonitis. The absence of liver dullness was not definite and was not commonly found. The presence of shock as defined by many present day laboratory determinations (hemoglobin, hematocrit, total protein, etc.) was not determined, but in seventy-two patients, or 36 per cent of cases, the admitting doctor stated that the patient was in shock. These patients were those seen soon after perforation and they were perspiring freely and their extremities were cool despite the fact that the blood pressure and pulse rate were usually within or near normal limits. The majority of those admitted thirty-six to forty-eight hours after perforation were prostrated and dangerously ill, presenting the clinical picture of generalized, late peritonitis. Laboratory examination usually revealed a leukocytosis of 13,000 to 18,000 if the patient was seen in the first eighteen hours after perforation, but this was not diagnostic or prognostic.

The patients' point of maximum tenderness was found in the epigastrium in 118 cases and in the right upper quadrant in

39 cases. Other recorded points of maximum tenderness were para-umbilical, right lower quadrant and left upper quadrant.

Roentgen examination of the patient in the upright position was performed in forty-eight cases. In twenty-nine cases,

TABLE IV

| Anesthesia | No. Patients | No. Died | Died (Per cent) |
|---|---|---|---|
| General | 66 | 14 | 21 |
| Spinal | 100 | 12 | 12 |
| Local | 2 | 0 | 0 |
| Sodium pentothal | 3 | 0 | 0 |
| Spinal—Sodium Pentothal | 6 | 1 | 17 |
| Spinal—general | 8 | 3 | 42 |
| Avertin | 3 | 0 | 0 |

or 60.4 per cent of those examined, it was positive for evidence of free air in the peritoneal cavity. This is a lower figure than that reported by Anderson, Allen and Packard[1] of 85.2 per cent and Klason[10] of 89 per cent. The nineteen patients in whom free air was not demonstrated in the peritoneal cavity by roentgenologic examination did receive surgery.

The most common mistaken diagnosis was acute appendicitis. This error was made in 3 per cent of the cases. DeBakey reports this error in his series, with percentages of 4.3 per cent and in other series from 5.6 to 20 per cent. This mistake was made in six patients and at operation a McBurney incision was made and was promptly closed for an upper abdominal incision when the true condition was found. Other mistaken diagnoses were cholecystitis with cholelithiasis (two cases) and coronary artery disease (one case).

### SURGERY AND HOSPITAL COURSE

Of the 200 patients there were twelve who were not operated upon either because they refused surgery or the patient was moribund on admission. In three cases surgery was delayed for more than twelve hours after the hospital admission, two patients with almost a thirty-six-hour delay. This was because one patient refused surgery early and in the other two patients the correct diagnosis was not made upon admission. Of the 188 cases seven methods of anesthesia were used. (Table IV.)

The method of approach to the upper portion of the peritoneal cavity was a right upper rectus (muscle splitting) in eighty-six cases, right upper paramedian in sixty cases, a transverse rectus in thirty-one cases and five cases each of left upper rectus and upper midline incisions. The ulcer site was classified as duodenal in 39.5 per cent, pyloric in 15 per cent and gastric in 45.5 per cent of the cases. This differs markedly from that reported by DeBakey as duodenal 51.2 per cent, pyloric 9.8 per cent and gastric 38.9 per cent, and Black and Blackford in ninety-six cases with eighty-seven duodenal (90.6 per cent), six gastric (6.3 per cent) and three pyloric (3.1 per cent). The exact site of the perforation is not definite in a great number of cases because of presence of edema and exudate. Dissection and identification are not reasons for delay in the repair of perforation. Three perforated malignant gastric lesions were found, two being lymphosarcomas and one an adenocarcinoma.

The method of surgical treatment of the perforation has changed much during this series. There were seventy-four simple closures of the perforation, eighty-seven closures with omental grafts, twenty-three closures with posterior gastro-enterostomies, three subtotal gastrectomies and one gastroduodenostomy. In earlier years the closure was usually done with a purse-string of catgut reinforced with silk. During the period in which the posterior gastro-enterostomy was in vogue the perforation was closed with two or three layers of interrupted silk Lembert sutures. The operative notes reveal that the operator attempted palpation of the lumen and thought that obstruction might follow and thus a gastro-enterostomy be necessary. During the past eight years this has

changed to the simplest method of closure: three or four interrupted Lembert silk sutures with omental grafts if easily available. There have been no cases of obstruction of the pylorus or duodenum after this simple closure.

Drainage was instituted in eighty-two cases. The site of perforation was drained fifty-nine times, the pelvis thirty-seven, pelvis and site of perforation seven, right gutter six, abdominal wall thirty-five and the left gutter once. The site of perforation was usually (forty-three cases) drained through a right upper quadrant stab wound. In all cases in which the pelvis was drained it was by use of a suprapubic stab wound.

Postoperative treatment has changed during this period. The first few years that this report covers, gastric suction was not used frequently until abdominal distention became quite marked. There was a great tendency not to allow any liquid or food by mouth for four to six days; this has changed in the past five years to sips of water after twelve hours postoperatively. It is interesting to note that in the first few years of this report food and liquids were not allowed by mouth for several days but that oral medications, such as antispasmodics, cough syrups and cathartics, were given often. Gastric suction is now used almost routinely for twelve to forty-eight hours. Parenteral feedings now include adequate amounts of protein and vitamins while from 1935 to 1943 the feeding usually consisted of only intravenous saline and glucose. Beginning in 1938 sulfa drugs were used in most cases, either intravenously, subcutaneously or orally, when the patient was able to take them. Since 1943 penicillin has been used in most cases. Early ambulation was instituted in 1944 and so far the patients seem to do better although this series is too small to report more than a trend.

The usual complications of wound infection, peritonitis and pulmonary disease were noted in about the same frequency as reported by other authors. The complications in order of frequency are listed in Table v.

MORTALITY

The overall mortality of this series is 26 per cent, and excluding those not operated upon the mortality is reduced to 20 per cent. Many factors are present which influence the mortality of those with this acute surgical emergency. Briefly these are as follows: the time interval between perforation and surgery, the age of the patient, correct diagnosis, anesthesia, surgical procedure, co-existing medical diseases, complications and use or non-use of chemotherapeutic and antibiotic agents.

TABLE v

| Complications | No. Patients |
|---|---|
| Wound infection | 24 |
| Pneumonia | 21 |
| Peritonitis | 17 |
| Atelectasis | 16 |
| Subhepatic, subdiaphragmatic abscess | 7 |
| Evisceration | 6 |
| Intestinal obstruction | 5 |
| Bands (small bowel) 3 | |
| Volvulus (small bowel) 1 | |
| Duodenum 1 | |
| Paralytic ileus, severe | 3 |
| Empyema | 3 |
| Hemorrhage | 3 |
| Septicemia | 3 |
| Thrombophlebitis | 2 |
| Delirium tremens | 2 |
| Cardia decompensation | 2 |
| Uremia | 2 |
| Parotitis | 1 |
| Gastric fistula | 1 |
| Jaundice | 1 |
| Lung abscess | 1 |
| Pulmonary embolism | 1 |

If the patient had the perforation and received reparative surgery within the first three hours, the chances for recovery were good, the mortality rate being only 4.7 per cent for this period. From the third to sixth hour after perforation the mortality rate rose to 11.6 per cent and then to 12.4 per cent for the six to twelve-hour period following perforation. After twelve hours the mortality rose sharply, 37.5 per cent for the twelve to eighteen-hour and

the eighteen to twenty-four-hour periods. Between twenty-four to thirty-six hours the mortality rate was 50 per cent and climbed to 100 per cent for the thirty-six to forty-eight-hour period. The mortality rate dropped to 50 per cent for all cases

TABLE VI

| Ulcer Site | No. Cases | Per cent of Cases | No. Cases Died | Mortality (Per cent) | No. not Operated | Mortality of Operated Cases (Per cent) |
|---|---|---|---|---|---|---|
| Gastric... | 91 | 45.5 | 24 | 26.3 | 6 | 19.7 |
| Duodenum | 79 | 39.5 | 23 | 29.1 | 4 | 24.0 |
| Pylorus.. | 30 | 15.0 | 6 | 20.0 | 2 | 13.3 |

in which perforation had existed for forty-eight hours or over. The last drop in mortality might be explained as a walling-off of the perforation thus showing a tendency toward spontaneous healing.

This series of cases further substantiate the often proved fact that the mortality rate rises steadily with the older group of patients. This may be explained in part by their greater number of concurrent and complicating illnesses, such as pathologic cardiac states, uremia, diabetes, jaundice, malnutrition, etc.

It was quite difficult to determine accurately the site of the perforation in most cases. As pointed out previously gastric ulcers predominated in this series with the general mortality of 26.3 per cent and a mortality of 19.7 per cent for those receiving surgery; duodenal ulcers produced a general mortality of 29.1 per cent and a mortality of 24 per cent for those receiving surgery and pyloric ulcers caused a general mortality of 20 per cent and a mortality of 13.3 per cent of those who underwent operation. (Table VI.)

Correct diagnosis was made in 95.5 per cent of the cases. Those incorrectly diagnosed as acute appendicitis did not affect the mortality. Those diagnosed as cholecystitis with cholelithiasis and coronary artery disease directly affected the mortality since the delay placed the patient in the time period group in which the mortality for all patients ranged from 37.5 to 100 per cent. Of these three patients only one survived the surgical procedure and the patients that died might easily have lived if the correct diagnosis had been made and the proper therapy instituted earlier.

During the period of this report many of the anesthetics were given by young and often inexperienced house officers and nurse anesthetists. The problems of anesthesia were not well understood by the anesthetists and surgeons. Intratracheal anesthesia with suction and controlled respirations was seldom attempted. Postoperative pulmonary complications were common. (Table V.) The mortality rate of the patients that had spinal anesthesia was 12 per cent in comparison to the 21 per cent mortality of those given general anesthesia and the 42 per cent mortality of those given a combined general and spinal anesthesia. Thus, it would seem that general anesthesia should be avoided whenever possible unless it is administered by a competent, well trained physician-anesthetist.

The mortality trends have been divided into three periods of four years each: The period of 1935 to 1938 reveals a general mortality of 28.5 per cent of all patients with a 24.2 per cent mortality rate for patients undergoing operations. This is the period in which the more complicated surgical procedures such as the two- and three-layer closure of the perforation, posterior gastro-enterostomy, transverse incision and suprapubic drainage of the pelvis were common. The period from 1939 to 1942 showed a drop in the general mortality to 20 per cent and to 15 per cent for those receiving surgery. This period was marked by the rather general abandonment of the transverse incision, the multiple layer closure of the perforation, the posterior gastro-enterostomy following closure of the perforation and the

suprapubic drainage of the pelvis. Chemotherapeutic agents were used rather frequently locally, orally, subcutaneously and intravenously. Undoubtedly these drugs saved many patients indirectly through their action in treating pulmonary complications as well as the peritonitis and wound infections. The period of 1943 to 1946 showed only a general mortality of 11 per cent with a drop to 7.5 per cent for the patients receiving surgery. Antibiotic agents made their entrance into this period and with the chemotherapeutic agents probably lowered the mortality by their combined effects on peritonitis and the prevention and treatment of pulmonary complications. Also during this period the simple, single layer closure of the perforation with omental graft was reemphasized and less frequent drainage of the peritoneal cavity was carried out.

Eviscerations made a difficult problem. Of the six eviscerations, only one patient recovered from it. In an analysis of the deaths of those with evisceration three patients had transverse incisions and one each a right rectus and right paramedian incision. Three patients had spinal anesthesia, one had general and one a combined general and spinal anesthesia. Two of these patients had had perforation over twelve hours prior to surgical intervention. The one patient that had an evisceration who lived had had the perforation occur only six hours prior to surgery; the abdomen was opened through a right paramedian incision under spinal anesthesia and a simple, single layer closure of the perforation of the ulcer was made with the addition of an omental graft.

Postoperative mechanical obstruction was another problem that caused a high mortality figure. There were three deaths, one due to a volvulus and two due to angulation obstruction of the small intestine by adhesive bands. Interestingly enough, all of those patients who died had suprapubic drainage of the pelvis.

There were two patients with diabetes and these patients died within three days following surgery. Both were almost moribund on admission to the hospital. Two patients developed delirium tremens and one of them died forty-eight hours postoperatively. Two patients had cardiac lesions which became progressively worse during their postoperative period and one died in cardiac failure. One patient developed jaundice postoperatively and one a gastric fistula. Both of these complications were fatal.

The most common complications of this series remain as wound infection, peritonitis and some pulmonary pathologic process. They play a major rôle in whether or not the patient will recover. The most important advances in therapy in the prevention and treatment of these complications have been the use of chemotherapeutic agents and antibiotics. In the prevention or attenuation of wound infection, peritonitis and pulmonary diseases such complications as evisceration, subhepatic and subdiaphragmatic abscess, empyema, septicemia and lung abscess become less frequent.

## SUMMARY

Two hundred patients with perforated ulcers of the stomach and duodenum were seen at University Hospital in a twelve-year period. The overall mortality rate was 26 per cent and 20 per cent for those who underwent operation. Sex, race and seasonal relationship did not show any prognostic trends in this series. The age of the patient was quite important in that the mortality rate rose with the age of the patient. The youngest patient was nineteen and the oldest seventy-six years of age. Sixty-two per cent of the patients were classified as laborers and the absence of the high-strung "ulcer type" patient was noted. Eighty-nine per cent of the patients had a history of previous gastric disturbances and 30 per cent a past history of moderate use of alcohol.

Correct diagnosis was made in 95.5 per cent of cases by use of history and examination which revealed a board-like rigidity

of the abdomen, muscle spasm, a quiet abdomen by auscultation, leukocytosis and x-ray evidence of free air in the peritoneal cavity. The most commonly used anesthetic was spinal and with it the patient mortality was lower (12 per cent) than that of general (21 per cent) and the combination of general and spinal (42 per cent). The abdomen was opened in many ways and the transverse incision was virtually abandoned after 1938. The right upper rectus incision became the popular choice followed closely by the right upper paramedian. Both of these incisions gave adequate exposure. The ulcer perforation was found to be gastric in 45.5 per cent, duodenal in 39.5 per cent and pyloric in 15 per cent of the patients. The lowest mortality rate was noted with the pyloric perforations and the highest with the duodenal perforations. (Table VI.) Three perforated malignant lesions were found and those patients died following closure of the perforation. During the series the more complicated procedures, such as multiple layer closure of the perforation and posterior gastro-enterostomy, were discarded for the simple, single layer closure and the omental graft because of a mounting mortality rate and more frequent complications. Suprapubic drainage has not been used for eight years and of the three deaths complicated by mechanical intestinal obstruction suprapubic drainage was present in each case. Postoperative therapy now consists of gastric siphonage for at least twelve to forty-eight hours, sips of water twelve hours postoperatively, adequate parenteral feedings with vitamins and amino acid preparations, chemotherapeutic and antibiotic agents prophylactically to combat and prevent peritonitis, wound infections and the pneumonities.

## CONCLUSIONS

1. Two hundred consecutive cases of perforated gastric and duodenal ulcers are reported covering a twelve-year period.

2. The age of the patient is important to the prognosis of the case.

3. The earlier the diagnosis is made and reparative surgery instituted, the better the prognosis.

4. Spinal anesthesia in this series was the safest anesthetic.

5. The upper right rectus or upper right paramedian incisions give adequate exposure, and the percentage of wound eviscerations is less than with transverse incisions.

6. A simple, single layer closure of the perforation with omental graft if available is all the reparative surgery that is needed.

7. Suprapubic drainage increases the risk of intestinal obstruction and has been virtually discarded in this clinic.

8. Chemotherapeutic and antibiotic agents should be used routinely.

9. Gastric siphonage is indicated postoperatively.

10. Parenteral alimentation with adequate intake of vitamins and protein is necessary.

11. Early ambulation has not had sufficient trial in this type of problem.

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McELHINNEY and Holzer reviewed over 300 cases of acute gastroduodenal perforation occurring in a twelve-year period at a general hospital. They found that the recent operative mortality has been halved because of prompter surgery plus the supplemental use of adequate doses of sulfadiazine and the antibiotics. (*Richard A. Leonardo, M.D.*)

# BRACHIAL PLEXUS ANESTHESIA*

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SINCE the introduction by Kulenkampff[4] of a technic for producing brachial plexus anesthesia by injection in the supraclavicular fossa, this route has been the one most frequently employed. The procedure has not been widely used, however, probably because of the difficulty of mastering the technic.

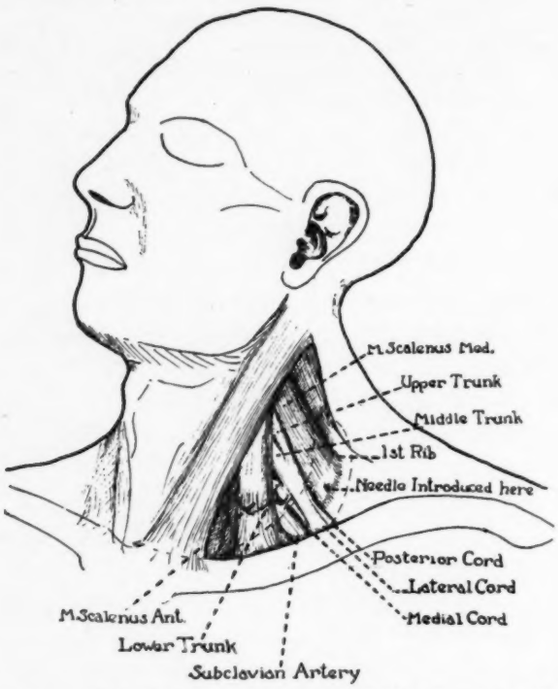


FIG. 1. Relationships of the brachial plexus in the supraclavicular region, left side. The position of the first rib is indicated by broken lines.

Brachial plexus anesthesia permits operation on the upper extremity in head injuries and in patients in whom thoracic complications, shock or other factors make it unwise to use general anesthesia. It facilitates tendon repair, as the patient may by contracting muscles facilitate the surgeon's identification of tendon stumps with minimal exposure. Brachial plexus anesthesia abolishes vasoconstriction in the upper extremity, permitting a better evaluation of the circulation when vasospasm and vascular injury must be differentiated.

The contraindications to the procedure are two in number: specific sensitivity to procaine and infection in or about the supraclavicular fossa.

Among the complications referred to in the literature,[3,5,7,9] namely, hematoma of the supraclavicular fossa, pneumothorax, residual paralysis and pressor effects due to the drug employed, the first two may be overcome by exactness in technic and the use of small caliber needles. Residual paralysis, according to Lundy,[7] does not result if procaine is employed. The transient pressor effects of procaine following injection are largely overcome with adequate preoperative sedation with morphine and by the addition of epinephrine to the anesthetic solution.

## ANATOMY OF THE BRACHIAL PLEXUS

The brachial plexus is derived from the anterior primary divisions of the fifth to eighth cervical nerves and the first thoracic nerve, with occasional contributions from the fourth cervical and second thoracic nerves. These nerves emerge in the posterior triangle of the neck between the scalenus medius and scalenus anterior muscles, extend in a downward and lateral direction invested on the outer surface by prevertebral fascia and converge to form three trunks. The upper trunk is formed by the nerve roots of C5 and C6, the root of C7 forms the middle trunk and the nerve roots of C8 and T1 form the lower trunk of the plexus. These trunks give off branches which supply the muscles of the shoulder girdle and converge as the first rib is reached. (Fig. 1.)

As shown in Figure 2 the plexus lies between the scalenus muscles in a fascial

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compartment which is formed anteriorly and laterally of prevertebral fascia. Medially the plexus is in contact with Sibson's fascia which attaches to the transverse process of the seventh cervical vertebra above and extends anteriorly and posteriorly between the sheaths of the scalenus anterior muscle in front and the scalenus medius muscle behind and terminates below at the medial border of the first rib.

The cervical pleura covered by Sibson's fascia rises above the sternal end of the clavicle because of the obliquity of the first rib (Fig. 4) although it rises nowhere above the head of the first rib. On the average the cupula pleurae rises about 1 inch higher than the clavicle.

As the plexus comes into relation with the first rib it retains its outer investment of prevertebral fascia, but is no longer invested on its medial surface, Sibson's fascia having terminated at the medial border of the first rib. The upper surface of the rib, therefore, now forms the floor of the compartment in which the plexus is situated.

*Relations of the Brachial Plexus at the First Rib.* Medially the plexus is in relation with Sibson's fascia and the cupula pleurae. Inferomedially the plexus is in contact with the upper surface of the first rib which partly encircles the lung below its apex. The subclavian artery lies anterior to the plexus between the scalenus muscles. Posterior to the plexus and partly covered by it is the insertion of the scalenus medius muscle. In this location the first rib extends in a nearly anteroposterior direction.

*Cords of the Plexus.* As the plexus crosses the first rib three cords are formed, named according to their relation to the subclavian artery (Figs. 1, 3 and 4.) The lateral cord, as the musculocutaneous nerve, supplies the arm flexors and the lateral aspect of the forearm and contributes to the median nerve. The medial cord supplies the medial aspect of the arm, forearm and hand; it also contributes to the formation of the median nerve, which has its origin in the axilla anterior to the subclavian artery, and supplies flexor muscles in the forearm and has a limited distribution in the hand. The medial cord is adjacent to the first rib. The posterior

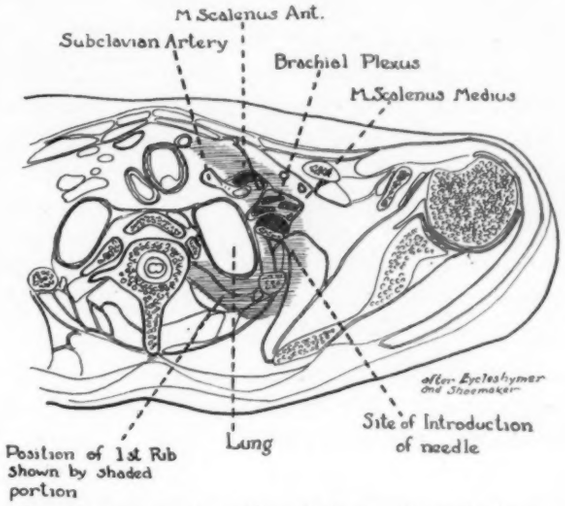



FIG. 2. Transverse section of the trunk at the lower portion of the first thoracic vertebra. The position of the right first rib is shown by shading. The plexus is seen to be in a fascial compartment between the scalenus muscles. (After Eycleshymer and Shoemaker.)

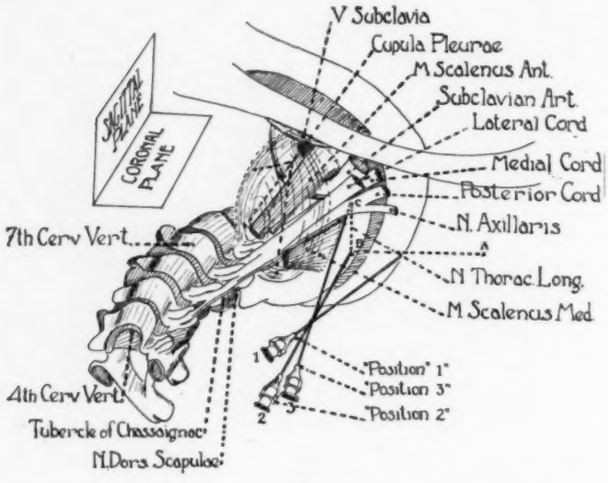
cord, unlike the other two, is extensor in function. It gives off the axillary nerve which has an important skin distribution on the posterolateral aspect of the arm in its upper part, and continues as the radial nerve which supplies the extensor aspect of the lower arm, forearm and hand.

*Other Branches of the Brachial Plexus.* The branches of the plexus which are given off cephalad to the first rib and diverge from the plexus necessarily escape inclusion in routine block performed at the lateral border of the first rib. Those supplied by the nerves $C_5$, 6 and 7 can be blocked, however, by a supplemental injection anterolateral to the transverse process of the sixth cervical vertebra (tubercle of Chassaignac) as suggested by Labat.[6]

This injection interrupts conduction over all these branches mentioned with the exception of the medial anterior thoracic

nerves (C8, T1), but this is not of much practical importance.

It is extremely important, however, to reach the intercostobrachial nerve (T1, 2) which does not enter into the formation of the brachial plexus, but which supplies the posteromedial aspect of the arm. This nerve, or nerves, comes off the corresponding intercostal nerves on the lateral thoracic wall, and after traversing the axilla beneath the axillary fascia, becomes superficial on the upper inner surface of the arm to continue subcutaneously as far distal as the elbow, having joined the medial brachial cutaneous nerve. The intercostobrachial nerve is relatively inaccessible through the supraclavicular fossa although Miltner and Chao[9] state that it can be blocked by this route.

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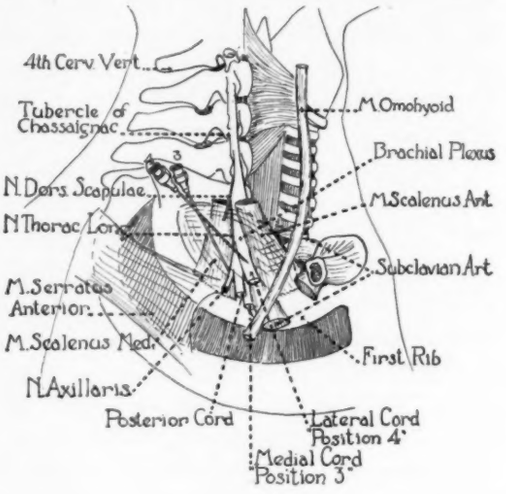


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FIG. 3. The relations of the brachial plexus in the right supraclavicular fossa. The diagram illustrates the brachial plexus in perspective visualized from the standpoint of the operator who stands facing the right shoulder of a supine patient whose head is turned and inclined to the left. The position of the cupula pleurae is shown by shading. FIG. 4. Lateral view of the supraclavicular region. The method of injecting on the lateral and medial aspects of the plexus is shown.

## TECHNIC OF BRACHIAL PLEXUS ANESTHESIA

The method here advocated, for which no claim of priority is made, takes advantage of the fact that the plexus traverses the first rib and utilizes the paresthesia first obtained as a means of identifying the point where the plexus traverses the rib, and as a means of orienting the needle to the various divisions of the plexus. At this point the fascial relationships are such that injection will necessarily be in the proper compartment. In order to accomplish these objectives, the rib is "walked" from posterior (where it is most readily palpable and superficial) to anterior, in which direction the plexus will be found from the arbitrary starting point employed. The rib acts as a gauge of depth of the needle and serves to guide the needle toward the plexus without danger of pleural puncture.

*Materials Required.* Procaine of 1 and 2 per cent to each ounce of which five drops of 1–1000 epinephrine has been added is used. The use of three needles is preferable. A No. 20 gauge, 1½ inches long, is used for injection of the plexus itself; an infiltration needle, No. 22 gauge, is used for the injection of the intercostobrachial nerve, and a shorter No. 22 gauge needle may be used for making the skin wheal and the injection at the tubercle of Chassaignac. Ordinary glass syringes of 10 to 30 cc. capacity are employed if the Luer-Lok type is not available.

*Preparation of the Patient.* Preoperative sedation should consist of ¼ or ⅙ gr. of morphine given thirty minutes beforehand. Barbiturates may create restless activity on the part of the patient, making it

difficult to detect impending procaine reaction; they are best used to treat such reactions after they appear.

The patient should be supine, his head near the end of the table and inclined to the side opposite that to be injected. A pillow interferes with the procedure. The skin preparation includes the lateral neck, supraclavicular fossa and the axillary aspect of the upper arm.

*Procedure.* The relationships of the supraclavicular fossa are now as shown in Figure 3 (right side) as the operator stands at the head of the patient. The posterior portion of the first rib is palpated, its forward course gauged and a wheal made in the skin at a point overlying the rib and mid-way between the anterior border of the trapezius and the clavicle.

The No. 20 needle is introduced through the wheal and in a somewhat lateral direction; this permits exploration at a safe distance from the dome of the lung. The needle is then worked cautiously medialward until it finds the first rib; it is then at point "B" or "Position 2."

The needle is then advanced in a forward direction along the rib until it strikes the plexus. The medial cord will, as a rule, be contacted first, as diagrammed in Figure 4 ("Position 3"). Ten to 15 cc. of procaine solution are now injected. The point of the needle is now medial to or "underneath" the plexus.

If the needle is then withdrawn and pushed forward again but in a direction paralleling the rib, it will strike the lateral cord. (Fig. 4, Position 4.) A similar amount of procaine solution is again injected.

The posterior cord is found by placing the needle in a position intermediate to the two preceding positions and again injecting procaine in the same amount. Having injected the plexus on its medial, lateral and posterior aspects, procaine is infiltrated along the superior surface of the first rib to a point approximately 4 cm. posterior to the plexus. Care should be taken that this latter injection be made deep to the cervical fascia and along the lateral aspect of the rib.

It is important to withhold injection of each cord of the plexus until a paresthesia has been obtained. Reliance should be placed on the observance of a definite muscle twitch corresponding to the distribution of the cord sought and not upon the patient's subjective sensations. Such motor paresthesias should always be obtainable for the medial and lateral cords although an extensor twitch indicating the posterior cord is, for some obscure reason, very difficult to obtain. Paresthesia is more difficult to elicit after a little procaine has been injected in the region.

*Supplementary Injections.* For anesthesia above the elbow infiltration of the intercostobrachial nerve is required. Using the long infiltration needle, a subcutaneous barrier of 1 per cent procaine is placed across the inner surface of the arm at the lateral boundary of the axilla; this should extend from the posterior border of the biceps muscle backward for a distance of 4 or 5 cm. transverse to the long axis of the arm.

In order to obtain anesthesia in the region of the upper arm and shoulder, injection at the tubercle of Chassaignac as described by Labat[6] is required. The transverse process of the sixth cervical vertebra lies opposite the cricoid cartilage. A wheal is made in the skin at a point overlying this process, lateral to the sternocleidomastoid muscle, and the needle is passed between the scalenus muscles to the process. When paresthesia is obtained, 5 to 10 cc. of 1 per cent procaine is injected, depositing some of the procaine at the anterolateral aspect of the tubercle and some above and below this between the scaleni. The total amount of procaine injected should not exceed 60 cc. of 2 per cent solution or its equivalent.

*Signs of Anesthesia.* Motor function and sense of pressure are usually not lost. Motor weakness, analgesia, loss of position sense and subjective sensations of increased weight and warmth of the extremity, how-

ever, indicate the onset of satisfactory anesthesia. Tests of skin sensation frequently defeat their purpose by creating apprehension in the mind of the patient.

## RESULTS

The technic outlined was used by the writer on 101 cases of upper extremity injury in Evacuation Hospitals of the United States Third Army in Europe in 1944 and 1945. In all these cases, the writer also acted as surgeon. The injuries in this group of cases were of all grades of severity and involved all portions of the upper extremity including the shoulder. The Kulenkampff technic had previously been tried; and although very successful in some hands, yielded success in only 66 per cent of cases in the author's hands.

The ideal sought was the production of anesthesia sufficient to permit surgery, débridement, nerve exploration, reduction of fractures, tendon suture, etc., to be carried out without complaint of discomfort or annoyance by the patient. When this result was obtained, it was recorded as a success. Failures were recorded according to cause. The results are tabulated in Table 1.

TABLE 1

| | Fingers to Wrist | | Forearm to Elbow | | Arm and Shoulder | |
|---|---|---|---|---|---|---|
| | No. | Per Cent | No. | Per Cent | No. | Per Cent |
| Total cases | 25 | .. | 37 | .. | 39 | |
| Failure | | | | | | |
| Psychologic | 2 | 8 | 0 | 0 | 0 | 0 |
| Duration | 1 | 4 | 2 | 5.4 | 2 | 5.13 |
| Technical | 1 | 4 | 1 | 2.7 | 3 | 7.68 |
| Other | 0 | 0 | 0 | 0 | 1 | 2.50 |
| Total failures | 4 | 16 | 3 | 8.1 | 6 | 15.4 |

Percentage of unsuccessful results ..12.85%
Percentage of successful results ....87.14%

*Technical Failure.* These cases represent failure to obtain anesthesia in a part of the upper extremity, so that the necessary surgical work could not be carried out. "*Duration Failure*" indicates those in which supplementary anesthesia, either an additional block or general anesthesia was required because anesthesia wore off before surgery was completed. "*Psychologic Failure*" was applied only to two cases with wrist level injuries who insisted upon general anesthesia, although the extent of the muscular relaxation and other signs indicated a good block up to the region of the shoulder. "*Other*" indicates that supplementary anesthesia was given but the reason for giving it is not ascertainable from the records.

## COMMENT

The use of pentothal sodium to supplement blocks which were "failures" from any cause furnished a good index of the degree of regional anesthesia present. The average amount of this drug used for this purpose was .45 Gm.; .3 Gm. was frequently sufficient to produce and maintain sleep while surgery was completed, indicating that some degree of regional anesthesia was present.

The results in the third group of cases involving the arm and shoulder indicate the value of Labat's supplemental injection at the tubercle of Chassaignac. Of these thirty-nine cases there were nine which involved the upper third of the arm and/or the shoulder; in this group, with Labat's supplement, there was one failure. In the remaining thirty cases in which the most proximal wound level was the junction of the upper and middle thirds, and Labat's supplement was not given, five were failures. Obtaining anesthesia at the higher level is, of course, more difficult than in the more distal, which suggests strongly that this supplement is of definite value in any above-elbow procedure.

The last thirty-five consecutive cases include only one failure. In this instance sufficient muscle relaxation to reduce a shoulder dislocation could not be secured. Brachial plexus anesthesia is not recommended for this purpose although it is occasionally successful when supplemented.

This type of anesthesia was found to be particularly suited to poor risk patients and cases complicated by other injuries, shock or poor general condition from any cause. Shock was observed to improve after the onset of anesthesia in some

cases; when it failed to improve it usually did not worsen unless the operating time was prolonged. In the presence of shock the duration of anesthesia proved to be considerably greater, at times lasting over three hours. When supplementation was needed, the amount of drug required was significantly diminished, indicating that the block had not been entirely without effect. The absence of vasoconstriction in the blocked extremity was frequently instrumental in the saving of structures which had at first appeared to be ischemic.

Reaction to procaine, other than readily controlled pressor effects, was not observed in this group of cases nor were complications observed other than hematoma of mild degree.


## SUMMARY

Infiltration of the brachial plexus through the supraclavicular fossa affords satisfactory anesthesia in the upper extremity when other factors preclude the use of general anesthesia. The brachial plexus crosses the first rib in an investment of fascia derived from the sheaths of the scalenus muscles and the prevertebral fascia; its medial aspect lies in relation to the first rib. The derivation and divisions of the plexus are described; these relationships indicate the need for injections at various points to ensure adequate infiltration and satisfactory anesthesia.

The technic advocated utilizes the constant relationship of the plexus and the first rib as a means of locating the plexus. By this method it is possible to inject two or more cords of the plexus individually, which provides increased likelihood of successful anesthesia. The necessity of injecting the intercostobrachial nerve for surgery in the arm, and at the tubercle of Chassaignac for surgery about the shoulder must be borne in mind. Observance of a motor twitch in the arm muscles, rather than subjective sensations reported by the patient, is believed to furnish a more reliable indication of contact with the plexus.

The results obtained by this method of administration in the writer's hands were good in 87 per cent of cases. The failures are tabulated according to cause; not all the failures were failures of the method itself. The anesthesia obtained permitted major surgery to be carried out with no complaint of pain on the part of the patient in the successful cases. The average duration of anesthesia was one and three-quarter hours; in cases in which shock was present satisfactory anesthesia not infrequently lasted for three hours.


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# CONSTRUCTION AND CARE OF THE PERMANENT COLOSTOMY

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ALTHOUGH most features of the abdominoperineal resection of Miles operation for carcinoma of the rectum have become standardized over the past forty years, the construction of the end colostomy is still performed by a variety of methods. Despite the enormous literature dealing with the basic principles of other portions of the operation, it is difficult to sift out the salient factors in the colostomy construction that insure a functional result compatible with successful social and economic rehabilitation of the patient.

Management of the end colostomy has been thoroughly studied and methods for management outlined in detail by several authors.[1,2,4,13] These methods presuppose the presence of a satisfactorily constructed colostomy for success. In our clinic we see failure of patient adjustment due to structural defects and to inadequate training of the patient. The colostomy bag is a badge of failure on both counts. This matter assumes great importance at this time when patients are aware of sphincter-saving operations and brings pressure on the surgeon for operations compromising fundamental principles of cancer surgery. Most patients facing the problem of colostomy revolt at the thought of the "bag" rather than the abnormal opening upon the abdominal wall. This appliance is responsible for much of the aversion to colostomy and should be eliminated following rectal resection. The avidity with which patients turn to sphincter-saving operations is evidence that all are not able to adapt to colostomy control regimens of one kind or another. This situation warrants our examination more closely of the factors entering into satisfactory end colostomy construction.

Review of technics advocated by surgeons widely experienced in this field shows no pattern of evolution. Most technical papers dealing with operative technic give little space to the details of the construction of the colostomy.

Miles[9] advocates colostomy through a muscle-splitting incision 1½ inches medial to the anterior superior spine of the ileum and avoidance of colostomy through the left rectus incision. Emphasis is placed upon the size of the muscle splitting wound which should be just large enough to admit the index finger. This size is recommended to prevent small bowel herniation. The bowel wall is anchored to the incision with silkworm sutures. No closure of the lumbar gutter is advised.

In 1935 Lahey[7] favored a 1 to 1½ inch protrusion of the bowel above the skin level, with anchorage of the bowel by suturing epiploic appendages to the wound and closure of the lumbar gutter. In 1946[8] the same author advises a 3 to 4 inch projection of bowel above the skin level, with a snug closure of the wound about the bowel and closure of the lumbar gutter as previously.

T. E. Jones[6] prefers to bring the colostomy out through the operative incision. However, if the loop is too short for this, it should be brought out through a left McBurney incision. This preference for colostomy close to the midline is so that the patient will appear symmetrical with his colostomy dressing. Jones does not advocate closure of the lumbar gutter.

Cattell[2] believes that end colostomies should project 1½ inches above the skin

level and should be well anchored to prevent prolapse or recession into the wound. A ½ inch projection of mucous membrane is desired as an end result. The bowel should be brought out through the wound and the peritoneum closed snugly about it while the fascia is closed loosely to prevent postoperative stenosis. In his experience late stricture is due to bowel wall receding and reaching the level of the skin.

Rankin[7,10] prefers to construct the end colostomy through a stab wound in the left lower quadrant and has found this easiest to make and easiest to control. This stab wound should be only 5 cm. in length and the peritoneal opening even smaller so that it will hug the bowel closely. The bowel is maintained in position by a Payr clamp and a piece of gauze is wrapped about the bowel down to the level of the peritoneum. No sutures are placed in the bowel wall or the epiploic appendages. Although purse-string closure of the lumbar gutter is advised in loop colostomy of the sigmoid, it is not recommended for end colostomy.

Daniel F. Jones[5] brought the colostomy through the operative incision and advised closure of the lumbar gutter. He also cautioned against the use of sutures between the bowel wall and the abdominal wall.

End colostomy through a left paramedian incision is advised by Shedden,[13] the bowel being drawn through a split in the proximal third of the left rectus muscle. This, he believes, is conducive to better control. Closure of the lumbar gutter is advocated.

Singleton[12] reporting on his one-stage perineo-abdominal resection of the rectum favors colostomy through a muscle-splitting incision on the left side. Colostomy through the midline incision may be done but he believes the former is less likely to result in herniation of the bowel. He does not close the lumbar gutter.

David[3] brings the colostomy out through a right or left muscle-splitting incision medial to the anterior superior spine of the ileum or at the lower angle of the operative incision. No attention is given the lumbar gutter.

## COMMENT

Evaluation of our own results on the Fourth Surgical Division of Bellevue Hospital resolves this problem into two sets of factors; (1) those concerned with morbidity and mortality and (2) those relative to rehabilitation of the individual.

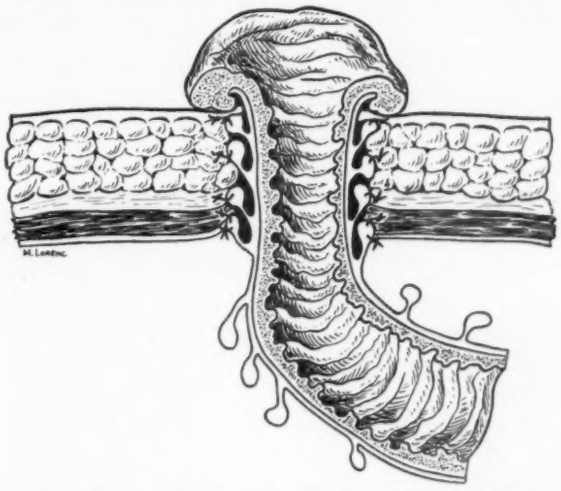

FIG. 1. Cross section of colostomy showing suture of appendices epiploica to abdominal layers.

Almost everyone agrees that no sutures should anchor the bowel wall to any portion of the incision. However, there is a definite need to stabilize the bowel. Whenever possible the epiploic appendages should be used for this purpose. There have been no complications from this procedure. This measure not only maintains the bowel in the desired relation to the abdominal wall but also obliterates the potential space existing around the bowel before sealing off of the peritoneum has taken place. This point warrants consideration as we have seen small bowels herniate through a colostomy stab wound with a fatal result. Most writers use the adjective "snug" in describing the closure of the wound about a colostomy but few give a method of quantitating this snugness. We have found that one's index finger should fit comfortably in the peritoneal opening beside the bowel, as has been advocated

by Cattell. The fascia need not be closed as tightly as the peritoneum. The fixations of epiploic appendages to peritoneum, muscle, fascia and skin hold out the bowel wall so that it fills the defect more adequately than if the mural structures were tightly closed about it. This method prevents inadvertant jeopardizing of the blood supply by constriction of the mesentery of the bowel wall in the wound. We have not had to deliver more bowel postoperatively because of slough of the bowel end. (Fig. 1.)

We have not encountered obstruction due to small bowel entering the opening between the bowel and the abdominal wall in the lumbar gutter, and do not consider closure of the space an important point. The literature reveals no universal opinion on its necessity. This step is advised only in those instances in which the loop is brought out through a stab wound in the left lower quadrant. When the loop is brought through a paramedian or rectus-splitting incision, the internal hiatus between bowel and abdominal wall is too large for closure. We have seen no instance of obstruction due to the small bowel becoming involved in the space between the colostomy and lateral parietal wall.

Morbidity and mortality have not been affected by the site used for colostomy. Where the colostomy has been brought out through the operative incision, we have had no difficulty with wound infection. This can be attributed to the thirty-six- to forty-eight-hour period allowed for sealing of the wound and the 2 to 3 inch projection of the loop and the routine preoperative use of succinylsulfathiazole. Rectal tubes or catheters may be sewed in a well projecting end colostomy to conduct feces and gas away while the wound is in the early stages of healing. We have not had success with this measure in the left colon and have come to depend on other factors to protect the wound from becoming infected.

The functional result and rehabilitation of the patient depend on the formation of a well projecting tight stoma. This should project 1 to 2 inches above the skin level after healing has taken place. This can be obtained if 2 or more inches of bowel protrude above skin level when the incision is closed. This projection can be roughly estimated before closure is begun and more bowel may be mobilized if necessary by dividing lateral peritoneal attachments. Occasionally this may necessitate freeing of the splenic flexure. Proper maintenance of the bowel protrusion is facilitated by suturing epiploic appendages to the skin. After the colostomy has been opened, the mucous membrane everts until it reaches skin level where it heals to the skin and its own serous surfaces adhere leaving a protrusion about one-half the original size. This process forms a tight stenotic rim at the skin level which barely admits the little finger at the end of a month but shows no tendency to become progressive thereafter. This feature is constantly found in the colostomies of those who make a satisfactory adjustment and wear only a small dressing. If the mucosa lies below the skin level, there will be a tendency toward prolapse of the bowel through the stoma in the early stages of healing, followed by progressive stricturing at the skin level necessitating later operative revision. Much has been written in the past about the proper degree of tension for suspension of the bowel in the wound so that late prolapse would be prevented. This has not constituted a problem when the proper stoma has been fashioned.

We have had no instances in which simple loop colostomy has proven satisfactory from the functional standpoint. Complete division of the bowel does not ameliorate the situation. The presence of two loops of bowel in close proximity in the wound fails to produce the tight block of tissue about the stoma associated with good control. In these unsatisfactory colostomies we have seen prolapse of the bowel and orifices that discharge almost continuously so that a bag is necessary.

Rehabilitation must be a simple arrange-

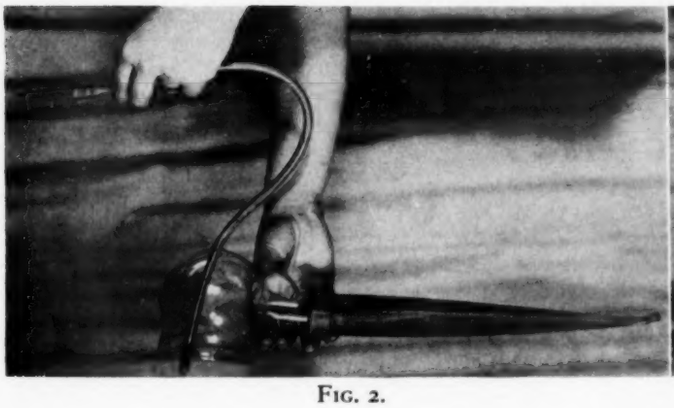

FIG. 2.

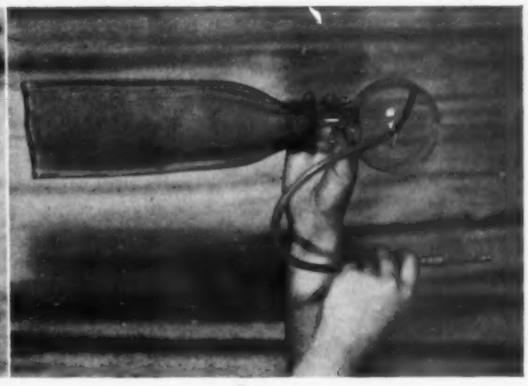

FIG. 3.

ment and lend toward adequacy and freedom from soiling at least for twenty-four hours. After healing occurs and the colostomy has reached its end result in healing so that the mucous membrane pouts above the skin 1 to 2 inches and the skin about the colostomy has stenosed down to its limit, proper instruction must be given the patient by the surgeon. This ideal is acquired in about four weeks.

The diet is a general one omitting only those articles of food which the individual patient knows by experience causes loose stools. On arising the patient irrigates the colostomy with about 1 pint of tap water using the simple devise here illustrated. (Figs. 2 to 4.) It is a glass bowl type of colostomy irrigator with a large opening. It is held against the abdomen at the colostomy. Then in front of the bowl is a small hole allowing the use of a 26 French rectal tube with catheter. Attached to the bottom of the bowl is a long rubber bag about 13 inches long through which the stool comes out into the glass bowl and down the rubber tube into the toilet on which the patient is sitting. When the irrigation is over, the patient sits there a while and then cleanses himself. He then puts on a dressing and a snug fitting abdominal support. The bulk and coldness of the water causes good peristaltic action with complete emptying of the colon. A small piece of gauze is applied to the stoma and the area stays clean for a period of at least twenty-four hours.

*March, 1949*

FIG. 4.

On such a regimen the patient is able to forget his colostomy, conduct himself as any ordinary individual and carry out his normal occupation with no inconvenience. The dread and fear of a colostomy is thus completely eliminated.

## CONCLUSIONS

1. The proper construction of an end colostomy is described.
2. The end result provides a controllable

colostomy which allows normal conduct of the patient.

3. Simplicity and good function are achieved.

4. A new irrigating device is described.

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According to A. A. Strauss a preliminary ileostomy or one done at the time of colon resections in a patient receiving sulfasuxidine therapy is perhaps safer for the surgeon to do than to attempt the one-stage closed method of resection of the colon. This statement, of course, does not hold true for surgeons experienced in this latter operation. (*Richard A. Leonardo, M.D.*)

# HIDRADENITIS SUPPURATIVA*

## ITS CONFUSION WITH PILONIDAL DISEASE AND ANAL FISTULA

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HIDRADENITIS suppurativa is a chronic inflammatory disease of the skin and subcutaneous tissue affecting those portions of the cutaneous surface of the body in which the apocrine sweat glands are located, namely, the axillary, mammary, inguinal, genital and perianal regions.

The disease is much more common than is generally appreciated. In the past it has frequently been obscured under such names as "abscess" or "furunculosis of the axillae or buttocks," "pyoderma," "fistulous disease of the buttocks" and "non-specific granuloma."

It is chiefly a disease of adults. Although the axillae are most commonly affected, any of the aforementioned sites of predilection, singly or in combination, may be involved. The condition usually affects well nourished robust persons who have an oily skin and acne diathesis.

In the early stage of hidradenitis suppurativa the lesion appears as a furuncle, usually axillary. Histologically, at this stage the apocrine sweat glands reveal primary involvement in an inflammatory reaction. The process may spread by means of the lymphatic channels and tissue spaces through the skin and subcutaneous tissue to a chronic stage, associated with draining sinuses, ulceration and undermining. Also in evidence is an attempt at healing as manifested by the thickened bands of scarring, granulation and relatively little cellular infiltration.

There is a predilection of the disease for certain regions of the body by an inflammatory reaction involving the apocrine glands. The apocrine glands, as distinguished from the eccrine sweat glands, are an adult structure activated at the time of puberty. In lower forms the apocrine gland operates as a scent gland of sexual function. These glands are not secretory like the eccrine glands and are frequently found to contain a cheesy material formed by the degeneration of the contents of the gland. Plugging of the ducts and subsequent infection produce the initial lesion which may progress to a chronic phase.

### CONFUSION WITH PILONIDAL CYSTS AND ANAL FISTULAS

As a disease entity hidradenitis suppurativa has failed to receive its proper recognition in the current literature. It is not uncommonly confused with pilonidal disease and anal fistula while the converse is also true. (Figs. 1 and 2.) It is our opinion that this fact, in part at least, explains some of the so-called recurrent pilonidal cysts as well as recurrent anal fistulas. Although the perianal or the lower mid-sacrococcygeal region may be involved alone, there is usually axillary evidence of the condition either past or present. It may be necessary to ask the patient a direct question as to axillary involvement since the process in that region may have been quiescent for years. The diagnosis of perianal manifestations of hidradenitis suppurativa is usually not difficult if the disease is thought of in cases of what appears to be extensive anal fistula or pilonidal disease with many sinuses. An examination with the patient under anesthesia may be necessary to enable one to make a differential diagnosis

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FIG. 1. *a*, extensive pilonidal cyst disease with multiple draining sinuses mistakenly diagnosed as hidradenitis suppurativa before operation; *b*, after wide excision *en bloc* and before skin grafting.

FIG. 2. Hidradenitis suppurative which was clinically considered to be a pilonidal cyst with multiple sinuses. Minimal involvement of the right axilla of the same patient should have aroused suspicion of hidradenitis.

between pilonidal cyst disease or anal fistula on the one hand and hidradenitis suppurativa on the other.

## STUDY OF 388 PATIENTS

Supporting the statement that hidradenitis suppurativa is much more common than is generally appreciated is the fact that in an eight-year period, from January 1, 1940 through December 31, 1947, the condition was diagnosed at the Mayo Clinic in 388 patients, 197 of whom were female and 191 male, or about an equal sex distribution.

The reason that the aforementioned eight-year period was chosen is that prior to 1939, in which year Brunsting's[1] article appeared, there was much confusion in the terminology used and consequently the records will show many different diagnoses in labeling this disease.

In this group of 388 patients the axilla was the most common site of involvement; that is, one or both axillae were involved, alone, or in combination with other sites in 278 patients (72 per cent of the total group of 388 patients). In this group of 278 patients the axilla or axillae were involved alone in 187 instances.

The mammary area was involved alone or in combination with other sites in thirty-two patients (8 per cent of the total group). The oldest patient was a woman aged sixty-nine years who had hidradenitis suppurativa in subcutaneous tissue under the breasts and also Schimmel-

busch's disease in the mammary glands. Perhaps this chronic cystic mastitis of the Schimmelbusch type could be considered a deep-seated hidradenitis. At least the apocrine glands are involved initially in both diseases.

The groin was involved alone or with other sites in ninety-two patients and the back of the neck in forty-four patients.

The second most common site of involvement was the perianal region. This was the site in 125 patients (32 per cent of the total group) of whom seventy-nine were male and forty-six were female. In more than two-thirds of these (eighty-four patients) there was co-existing single or bilateral axillary involvement. The remaining forty-one patients had peri-anal involvement of the disease alone or with scrotal or labial involvement. It is with this group that our study is particularly concerned. In most of this group of forty-one patients in whom the perianal area *alone* was involved the diagnosis was quite apparent after the history and examination but in four instances the diagnosis proved to be an extensive fistula in ano after examination at the time of operation when the patient was anesthetized. Several other patients gave a history of having undergone an unsuccessful operation for a pilonidal cyst or an anal fistula which actually proved to be hidradenitis suppurativa instead of the disease for which operation had been performed.

## TREATMENT

When the disease is far advanced and fails to respond to conservative measures such as roentgen therapy, the involved perianal regions are excised *en bloc*. (Fig. 3.) The excision should include all of the fibrous or inflamed portions of the subcutaneous fat and connective tissue. All sinuses and epithelial skin bridges should be explored and excised. Extensive denuded areas may require skin grafting.

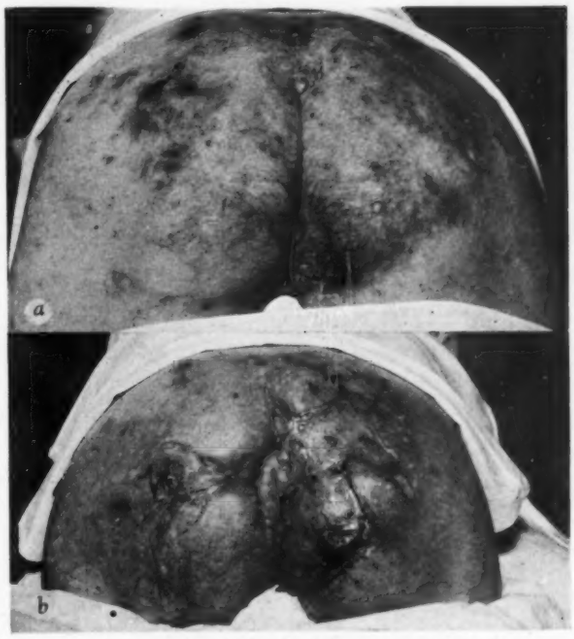


FIG. 3. *a*, extensive hidradenitis suppurativa; *b*, same patient after excision *en bloc* and skin grafting.

## COMMENT

Most patients who have peri-anal hidradenitis suppurativa will have co-existing involvement of other sites of predilection, usually axillary. When the condition affects the perianal area alone as it did in forty-one cases (11 per cent of the group studied), the differential diagnosis should include fistula in ano as well as pilonidal cyst disease.

At least some of the cases of so-called recurrent pilonidal cysts or anal fistulas are actually cases of recurrent or new areas of involvement with hidradenitis suppurativa.

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# CLINICAL USE OF OXYCEL IN MINOR ANORECTAL SURGERY*

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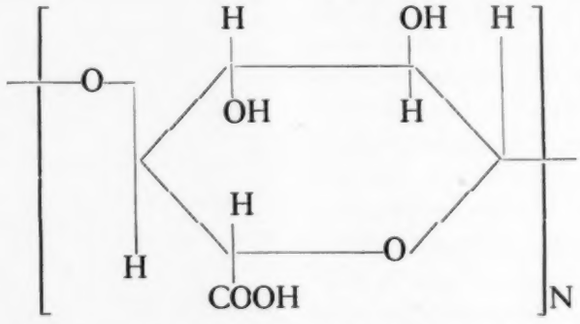
STIMULATED by reports in the literature of a new, absorbable hemostatic agent, Oxycel, used in various parts of the body, it was thought that this might be particularly useful in minor anorectal surgery. This report represents our findings in a series of 478 cases in which oxycel was used as a hemostatic agent.

Oxycel is the proprietary name given to cellulose which has been oxidized by the use of nitrogen dioxide or tetroxide converting unoxidized cellulose into polyanhydroglucuronic acid.




This is an absorbable hemostatic agent giving rise to minimum tissue reaction and it is relatively non-irritating. Pathologically, the tissue reaction is limited to the presence of a few polymorphonuclear leukocytes and the formation of a gelatinous mass which is microscopically absent within a thirty-day period. The specific hemostatic property of oxycel seems to depend on the formation of coagula apparently consisting of salts of cellulosic acid and hemoglobin. Clinically, when oxycel is inserted into a bleeding wound, it turns black, swells and has the adhesive tenacity of a true clot. Subsequently, it forms a gelatinous mass which is completely absorbed within thirty days with no apparent ill effects or, as in the case of surface application, the gelatinous mass is expelled or can be flushed from the surface of the tissues within a period of three or four days.

## TECHNIC

We have used oxycel as a hemostatic agent in a series of 478 cases divided between acute and chronic anal fissure, hemorrhoids and anorectal fistulas. The operative procedures employed adhered largely to the open technic. A hemorrhoidectomy was performed by ligation of the pedicle and excision of the hemorrhoidal mass after the method of Hirschman. All anorectal fistula operations were done by an open method of completely uncovering the fistulous tract and eliminating the internal opening of the fistula. Fissures were excised in their entirety and left open. Suturing within the anorectal canal and at the anal margin was kept to a minimum and was used only to secure blood vessels adequately. It must be stressed that oxycel was not used as a substitute for careful surgical technic for all obvious bleeding from arteries or veins must be ligated. In using this open method

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of operation a fair amount of venous and capillary oozing occurs without a demonstrable point of hemorrhage. An open incision or wound in this area is particularly suitable for such a hemostatic type of dressing.

It must be stressed that this oxycel "whistle" does not act as a foreign body due to its size. It does not resemble the old, large sized "whistle" in any way. It has been our experience that the method of choice is number (3), the oxycel "whistle,"

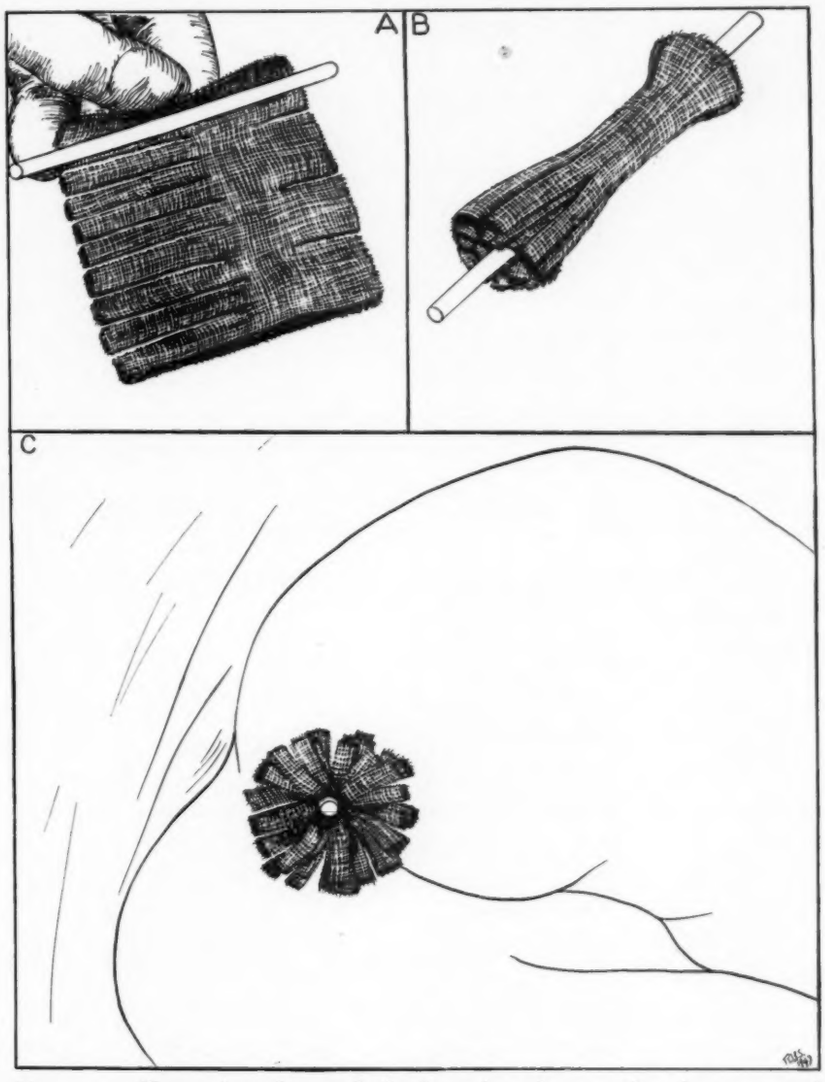


FIG. 1. A, illustrating the method of cutting the oxycel strip; B, oxycel "whistle"; C, oxycel whistle dressing in place. The patient is in a left Sims position.

METHOD OF USE

In minor anorectal surgery we have used oxycel in one of three ways, namely, (1) alone; (2) oxycel wrapped around a small piece of gauze inserted as a dressing; (3) an oxycel "whistle" made by wrapping the oxycel around a No. 12F. hard rubber catheter approximately 4 inches in length. as this allows the patient to expel gas, the retention of which has been a source of discomfort to some patients. This small oxycel "whistle" is inserted at the conclusion of the operation and because of its small size does not act as a foreign body and produce painful postoperative sphincter spasm. Oxycel fibers are spread

out in a radial fashion to cover the open incisions as illustrated. (Fig. 1.) A small piece of gauze is placed over the surface of this, the outer dressings are applied and the patient is returned to his room with the dressing in place. Postoperatively, no active effort is made to remove or withdraw the oxycel dressing. It dislodges itself spontaneously in one of the first few Sitz baths taken by the patient on the first or second postoperative day. However, if one desires, the small rubber tube may be removed without discomfort the next morning and the patient can take a Sitz bath an hour or two after its removal. In many cases it is not necessary to remove this catheter the first postoperative morning unless one wishes to relieve the patient of any anxiety regarding the condition of his recent operative site. By inspecting the wound, the patient can be given assurance that everything is progressing satisfactorily.

## COMMENT

We have been impressed by the superior hemostatic effect exerted by the oxycel dressing upon venous and capillary oozing. Postoperative hemorrhage was not encountered in this series of cases either in a delayed form or from small capillary oozing at the site of the surgical incisions. Secondary hemorrhage due to the removal of gauze or rubber tissue drains is eliminated by the use of oxycel and the mental comfort of the patient is thereby enhanced. It is also of interest to note that during the postoperative period before the oxycel was expelled or removed the patient did not have any feeling of a foreign body within the anorectal canal. Therefore, we believe that there is less sphincter spasm and probably less reflex urinary retention in this series of cases. It is also to be noted that the majority of patients expelled the oxycel dressing in the Sitz bath or in the toilet the first or second postoperative day. Following the expulsion of the oxycel we noted that our incisions tended to progress in a normal and satisfactory manner.

Although some retardation of epithelialization has been observed in cases in which oxycel has been left *in situ* for a prolonged time, this is not true here as the oxycel is removed within twenty-four to thirty-six hours.

Oxycel is not recommended for a surface dressing of open wounds except for hemostasis and, therefore, it should be removed when this purpose has been fulfilled. It has also been of considerable importance to us to note that in using mucous membrane as a modified graft overlying the suture line following repair of the sphincter there has been no distortion or displacement of the graft by the oxycel. The graft is not disturbed whatsoever when the oxycel is removed or expelled.

I would like to point out also that oxycel should not be left in an infected or potentially infected incison or wound in the anorectal areas as, in all probability, it will act as a media for continued suppuration and delayed healing. This should be particularly true of all deep sinus tracts and fistulae and in cases where it is used as a hemostatic agent following removal of a pilonidal sinus by the open method. If the deep portion of a fistula wound is inspected the third or fourth day following operation and it is discovered that the oxycel is not completely removed, it would be wise to flush this out with saline at that time. If we fail to remove the oxycel in these infected wounds, we can anticipate an undesirable effect from the retained oxycel as a continued source of suppuration.

## CONCLUSIONS

1. Oxycel has been used as an effective hemostatic agent in a series of 478 cases of minor anorectal surgery.

2. Oxycel is not a substitute for careful surgical technic but rather an adjunct to it.

3. Oxycel finds its greatest use in controlling the venous and capillary oozing associated with wounds of the anorectal canal.

4. Oxycel gives rise to a minimum tissue reaction. It is relatively non-irritating, does not delay healing in any fashion and in all cases used it was expelled without any untoward reaction on the part of the patient.

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Roddenberry and Muzzato tried out the value of tyrothricin in the form of local applications to recently operated patients with infected pilonidal cysts (cysts excised). The raw postoperative area was packed daily with a fine gauze mesh soaked in 1: 5,000 tyrothricin. This was supplemented by local irrigations of this solution every four hours. Results were highly satisfactory and proved this to be the most effective therapy. Local therapy with penicillin was the next most effective treatment. Tyrothricin caused disappearance of all the various mixed organisms that usually contaminated such wounds, with the sole exception of Bacillus proteus. Surgeons should be more careful with the postoperative treatment of patients after total excision of the pilonidal cyst. I have had cases in which infection refused to heal for six to ten weeks or which even recurred. I am sure that had I thought of using tyrothricin in these cases, convalescence would have been greatly shortened and fewer patients would require reoperation because of the severe postoperative infection present. Let us not forget tyrothricin as an important topical antibiotic.

*(Richard A. Leonardo, M.D.)*

# THYROID SURGERY*

## POSTOPERATIVE PROBLEMS AND COMPLICATIONS

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SUCCESSFUL surgery of the thyroid gland is dependent primarily upon proper preoperative preparation. It is necessary to have had careful coordination between the internist, the anesthesiologist and the surgeon. During early thyroid surgery it was not uncommon to have a mortality rate from 40 to 50 per cent. This was due primarily to hemorrhage and sepsis. We have seen a gradual decline from this prohibitive rate down to 1 of under 1 per cent. In order to obtain such a low mortality rate it is necessary to give attention to every detail, especially the prevention of any complications. One must allow enough time to elapse between the first contact with the patient and the time of surgery so that toxicity may be almost completely controlled.

The subject falls naturally into three divisions: first, preoperative; second, operative; and third, postoperative. These aspects will be discussed in chronologic order.

It is not the purpose of this paper to discuss all the relative merits of Lugol's solution as compared with thiouracil or propylthiouracil. There are strong advocates for all. There are also those who thoroughly condemn the use of thiouracil; for example, Dragstead[1] believes the drug to be too dangerous for routine use in preparation of the goiter patient and does not allow its use on his service at the University of Chicago. To quote: "I believe the drug thiouracil is more hazardous than surgery."

According to Van Winkle et al.[2] the reasons for the dislike of thiouracil are evident in this table of side-effects among 5,745 patients receiving the drug.

TABLE 1

TOTAL INCIDENCE OF SIDE EFFECTS OF THIOURACIL

| | Per Cent |
|---|---|
| 1. Leukopenia (white count below 4,000 with normal cell distribution) | 4.4 |
| 2. Agranulocytosis or granulocytopenia (total count below 4,000, with relatively greater disappearance of granulocytes, plus fever and pharyngitis) | 2.9 |
| 3. Drug fever | 2.7 |
| 4. Skin eruption | 3.3 |
| 5. Less frequent complications: (nausea, dizziness, headache, abdominal cramps, parotitis, joint pains, jaundice, diarrhea, and edema) | |
| Total incidence | 13.3% |

Payne[3] called attention to the possible development of malignancies in toxic diffuse goiters by the use of thiouracil.

Propylthiouracil seems to carry a lower incidence of complications and side effects. However, Lahey[4] reported "untoward effects in 2% of 300 patients where this drug was used in preoperative preparation." He reported one case of drug fever and five cases of white cell depression. One of these cases progressed to agranulocytosis.

Recently Eisenmenger[5] reported a case of leukopenia that developed after thiouracil therapy. Propylthiouracil was then substituted and severe leukopenia again developed. The patient was then successfully prepared with Lugol's solution.

Livingston[6] reported a case of agranulocytosis followed by hepatocellular jaundice after the use of propylthiouracil.

It is evident from this that while propylthiouracil is a definite improvement over thiouracil, it still is a dangerous drug to use in preoperative preparation. The blood counts of all patients who are using propylthiouracil should be checked frequently for

* Read before North Pacific Surgical Society 34th Annual Meeting, Victoria, British Columbia, November 21 and 22, 1947.

leukopenia in order that agranulocytosis does not develop.

It has been my experience that however toxic a patient may be, he can be successfully prepared by the careful use of Lugol's solution unless he is a member of a small group of patients who do not respond well to iodine. These patients can be prepared with either propylthiouracil or thiouracil.

No matter what drug is used certain criteria must be fulfilled. First, the patient must show a satisfactory gain in weight. Second, there should be a gradual drop in the pulse rate. The pulse rate should be under 110 and preferably below 100 for several succeeding days before surgery. Third, there should be a lowered basal metabolic rate. Fourth, the appearance of toxicity should have disappeared to a very large degree.

It usually takes from two to five weeks to accomplish the criteria desired. This time element may be considerably lessened if one cares to use sodium iodide intravenously. It is not uncommon to see the pulse rate and the well being of the patient greatly improved by the use of sodium iodide intravenously in from three to seven days. I have used sodium iodide intravenously only in those patients who were seriously ill from toxicity and have found very encouraging results. However, one must not disregard the time element of from two to five weeks' preparation even though the patient's pulse and condition has improved tremendously after the intravenous injections of the drug.

### OPERATIVE COMPLICATIONS

*Hemorrhage.* Hemorrhage is one of the most common and one of the most serious complications of thyroid surgery. The rich blood supply of the normal thyroid gland plus the greatly increased blood supply of the toxic diffuse goiter and the large vessels overlying and about the adenomas make hemorrhage always a grave possibility.

Hemorrhage during the operation can be combated by the use of intravenous fluids, plasma and even transfusions if necessary. However, gentle handling of the gland and careful securing of the vessels will prevent serious hemorrhage.

Hemorrhage occurring postoperatively is potentially very dangerous. The clot producing pressure on the trachea may make life very short unless this is relieved immediately. It is well to open the wound in the room and evacuate the clot before the patient is returned to surgery. After the patient is returned to surgery the clot can be fully removed and the bleeding point secured. In the patients operated upon at Good Samaritan Hospital during the past two years there was one postoperative hemorrhage occurring on the second postoperative day. The surgeon took this patient back to surgery.

Usually bleeding has occurred from either the superior or inferior thyroid artery after a tie has slipped off. It is my belief that the superior thyroid artery should be transfixed and ligated with an atraumatic needle at the time of surgery. The inferior artery should be divided far enough away from the capsule so that it can be tied well.

To prevent hemorrhage further, the remnants of the gland on each side of the trachea can be sewed with a running catgut stitch. This will cover over the raw surfaces and prevent further oozing. It is well to allow the patient to awaken before closing the strap muscles. He then will strain and cough and, if there are any collapsed vessels, they will readily be found at this time.

Hemorrhage under the flap is never serious. A small localized hematoma may be left alone. If there is much hemorrhage under the flap, it is best to take the patient back to the operating room, clean out the blood and tie the bleeding vein. Otherwise the scar will be unsatisfactory in appearance.

*Hole in the Trachea.* Hole in the trachea may occur accidentally at any time but is more likely to occur at secondary operations or in malignancies when the gland is very adherent to the trachea. If this

accident occurs, the anesthesia can be deepened while the hole is closed. It should never be a serious complication although infection may develop. For this reason a drain should always be inserted.

*Hole in the Pleura.* A complication which may occur is opening the pleura

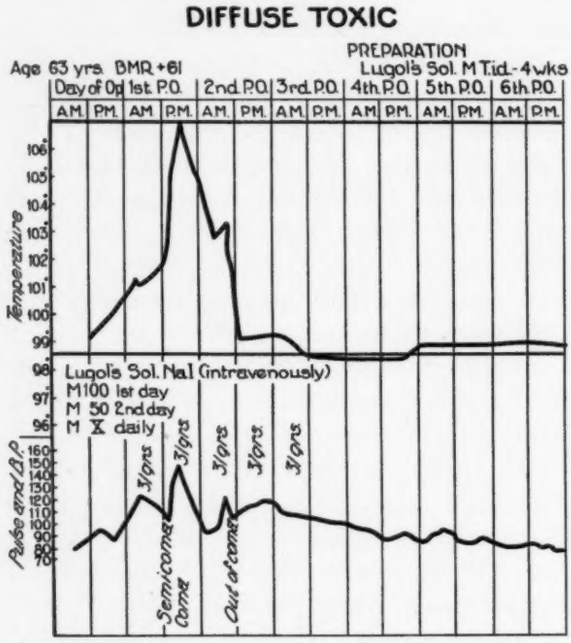


FIG. 1. Showing thyroid crisis with abrupt rise in temperature and pulse rate. There was an abrupt fall of the temperature and pulse following use of sodium iodide and glucose intravenously.

when removing a substernal adenoma. The pleura is frequently attached to the adenoma and it is necessary to slide the pleura off carefully before a hole is made.

*Crisis.* Formerly many patients died from thyroid crisis. Today this condition is seldom seen and then only in those unfortunate patients who have been carried on Lugol's, thiouracil or propylthiouracil over a long period in an attempt to cure the hyperthyroidism by the administration of drugs. With careful and more prolonged preparation of the thyroid patient, postoperative crisis has fallen off markedly. It still may occur.

Prevention by judicious and prolonged preoperative treatment is most important in preventing crisis. Bed rest, a high caloric diet of from 4,000 to 5,000 calories per day, high fluid intake and the proper amount of rest are all important preventive measures. Rest may be secured through the use of sedatives. Phenobarbital (gr. 1½) at night and tincture of opium (15 m.) two or three times a day, usually will secure the necessary amount of rest. Compound solution of iodine is, in my opinion, the treatment of choice. This is usually given by mouth except in the very severe case when intravenous sodium iodide is helpful. Intravenous glucose may be necessary and should be given once or twice a day unless the fluid intake is adequate.

In this series of 100 cases there was one postoperative crisis:

CASE I. This sixty-three year old woman had been placed in the hospital under the care of an internist. (Fig. 1.) She was brought under control by the use of Lugol's solution and then allowed to return home. After three months she was returned to the hospital markedly nervous with a high basal metabolism rate and a high pulse rate.

After what was considered proper premedication, I operated on her with no unusual difficulty. Her postoperative course was normal and mild until 8 P.M. the second day. Her pulse rate increased from 90 to 160 and her temperature rose from 100 to 160°F. The patient developed a severe crisis. She was given intravenous glucose supplemented by sodium iodide several times. After about two hours the crisis abated. The illustration shows the rapid rise in temperature and pulse rate once the patient's crisis was under way, and also the rapid drop in temperature and pulse rate after the sodium iodide and intravenous glucose had time to get in their work. This patient has been well for the past four years.

CASE II. This twenty-one year old woman had been operated on for a very toxic diffuse goiter at the age of thirteen years. She was extremely toxic during her presurgery hospitalization. The internist prepared her for six weeks with thiouracil and then for two weeks with Lugol's solution.

Following surgery the rise in temperature to 102½°C. can be seen on her first postoperative day and the rise in pulse rate to 145. (Fig. 2.) She was given not only 100 drops of Lugol's solution the day of surgery but also

31 gr. of sodium iodide. This was repeated twice daily until the fifth day. Her toxicity, manifested by the increased temperature and pulse rate, at that time began to drop and steadily fell to about normal on the sixth day.

CASE III. This twenty-three year old woman entered the hospital after having been given

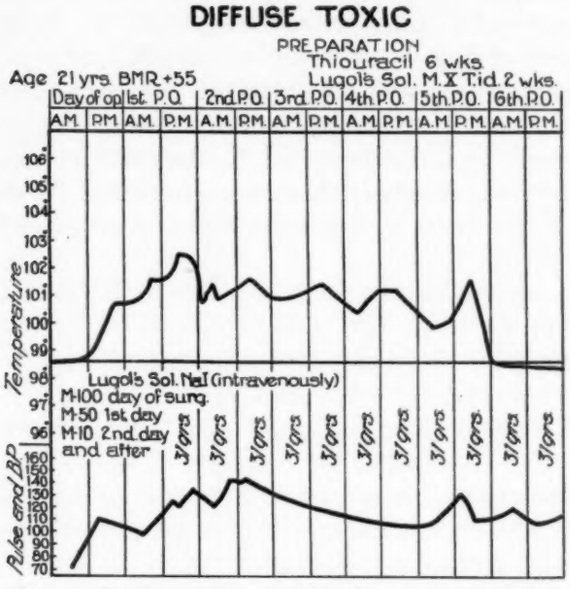
DIFFUSE TOXIC
PREPARATION
Thiouracil 6 wks.
Lugol's Sol. M.X T.id. 2 wks.
Age 21 yrs. BMR +55
Day of op. 1st. P.O. 2nd. P.O. 3rd. P.O. 4th. P.O. 5th. P.O. 6th. P.O.
A.M. P.M.
Temperature
Lugol's Sol. NaI (intravenously)
M-100 day of surg.
M-50 1st. day
M-10 2nd. day and after
3 grs.
Pulse and B.P.

FIG. 2. Postoperative toxicity in recurrent diffuse goiter controlled by use of sodium iodide and intravenous glucose.

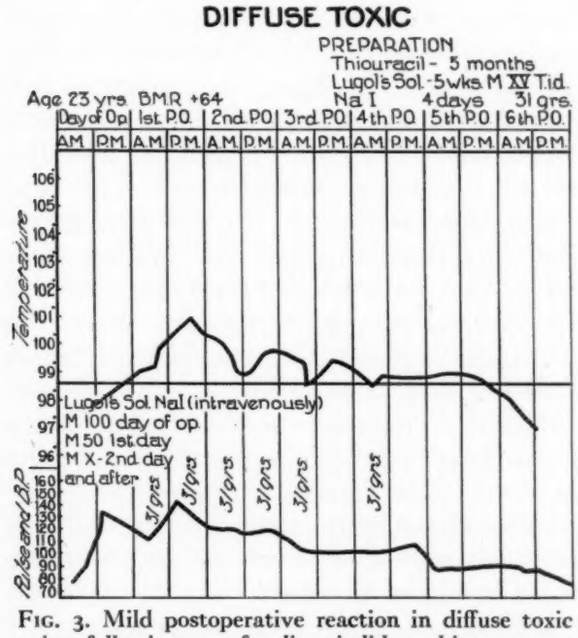
DIFFUSE TOXIC
PREPARATION
Thiouracil - 5 months
Lugol's Sol. - 5 wks. M XV T.id.
Na I 4 days 31 grs.
Age 23 yrs. BMR +64
Day of Op. 1st. P.O. 2nd. P.O. 3rd. P.O. 4th. P.O. 5th. P.O. 6th. P.O.
A.M. P.M.
Temperature
Lugol's Sol. NaI (intravenously)
M 100 day of op.
M 50 1st. day
M X - 2nd. day and after
3 grs.
Pulse and B.P.

FIG. 3. Mild postoperative reaction in diffuse toxic goiter following use of sodium iodide and intravenous glucose.

thiouracil over a five-month period in the middle west. She had lost in weight from 125 pounds down to about 95 pounds. At the time she entered the hospital she was unable to retain food because of nausea and vomiting. She was placed on 10 m. Lugol's solution three times a day and also, for two days, 31 gr. sodium iodide given intravenously once daily. Nausea and vomiting stopped within forty-eight hours.

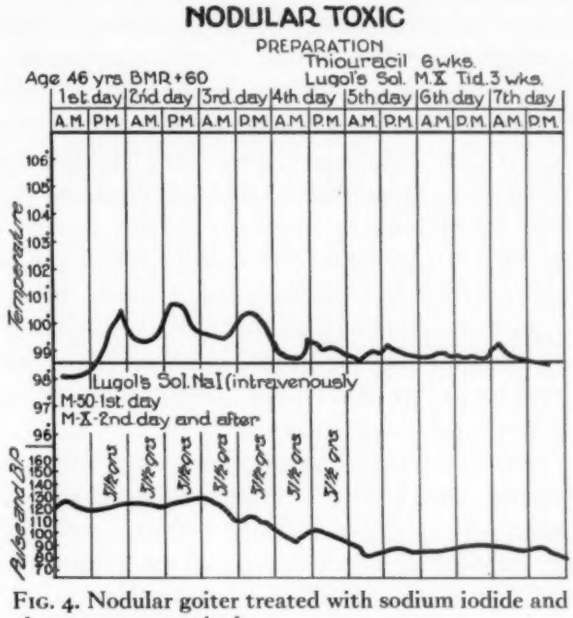


FIG. 4. Nodular goiter treated with sodium iodide and glucose postoperatively.

After a period of preparation she was operated upon and one can see by the graph (Fig. 3) that with the use of Lugol's and sodium iodide twice daily she made an uneventful recovery.

CASE IV. This forty-six year old woman had a nodular, very toxic goiter and a basal metabolic rate of plus 60. She was prepared for two months with thiouracil, and with Lugol's solution, 10 m. three times a day for two weeks. It will be noted that following surgery with the use of sodium iodide and Lugol's solution her temperature rose only to 100°F. on the first postoperative day and her pulse rate was only 130. (Fig. 4.)

In comparing Figures 2 and 3 with Figure 1, one can see how much smoother convalescence these two patients made after the use of sodium iodide intravenously. A thyroid crisis could have developed in either of these patients and, in my opinion, would have occurred without intravenous sodium iodide.

There are certain factors which are very valuable in preventing crisis. First, intra-

venous glucose, given both pre and postoperatively is very important. All toxic patients receive 1 to 4 Gm. of sodium iodide per day depending upon the amount of toxicity, pulse rate and appearance. If their toxicity is severe, they are placed in an oxygen tent. This will make them much more comfortable, often dropping their temperature from one to three degrees. They may be left in the tent for a few hours or a few days if necessary. Aspirin is given by mouth or by rectum in cases of pending or actual crisis. This will promote sweating and consequently a desirable fall in temperature. Lugol's solution given postoperatively is valuable and is given in 30 to 100 m. per rectum the first day, then 5 m. daily for three months more. This will help to prevent the thyroid remnents from hypertrophying.

One-sixth gr. of morphine is used for rest during the first few hours after surgery. After this 1 gr. of codeine sulfate and 1½ gr. nembutal are used to secure relaxation and rest. If morphine is continued over any great length of time, it may prolong any nausea and vomiting.

*Recurrent Laryngeal Paralysis.* Recurrent laryngeal paralysis is the most distressing of all the complications. All patients should have their vocal cords studied by a competent otolaryngologist before thyroidectomy is carried out. In a study of a large series of presurgery cases it has been found that about 10 per cent have unilateral vocal cord disability. The pressure on the recurrent nerve has been so gradual that compensation has occurred rather easily and unnoticed. For several years Lahey[7] has dissected the nerves at the lower end of the gland. He believes this has prevented injury to the nerve. Pemberton[8] believes this is unnecessary as you see only the lower part of the nerves and that, as a rule, injury to the nerve is done near the superior pole. If one leaves a small amount of gland at the posterior capsule, the nerve is protected.

Injury to one nerve will leave that vocal cord powerless. One has two choices as to what to do. First, it can be left alone and usually will cause little trouble. This is undoubtedly the treatment of choice. There is always a temporary change in the voice. After a time the voice will recover somewhat although it never completely recovers its full range. Second, the neck can be reopened and the nerve dissected to see if the nerve has been tied. If so, this can be remedied by simply cutting the suture. If the nerve has been divided, the ends can be resutured. Suturing of the nerve has not proven very satisfactory. However, most of the suturing has been done on old, fixed cords.

In injury to both recurrent laryngeal nerves both the adductor and abductor muscles are paralyzed so both cords are in a flaccid position. There are four procedures which may be carried out: (1) Tracheotomy which is often a life saving procedure; (2) resection of one of the paralyzed cords as described by Hoover.[9] This gives the mucous membrane lines airways in the larynx but, as a rule, a very poor voice. (3) Brien King's[10] operation consists of disarticulating the arytenoid cartilage and displacing it outward in a position of outward rotation and attaching it to the border of the thyroid cartilage. Dr. King has performed this operation 101 times. (4) Heyd[11] reports thirty cases of vocal cord paralysis. He has shown that the great majority of vocal cord disabilities following thyroidectomy are due to traumatism and not due to severance. They have treated their patients with steady cathode galvanization over the nerve and interrupted muscle stimulation over the laryngeal muscles on the affected side with which ever current is needed for a good contraction of the vocal cords. If the original examination shows that some faradic response is preserved, the outlook is excellent and restoration within three months can be expected.

*Tetany.* Tetany is a very infrequent complication. This usually occurs in secondary operation. It is due to the fact that two or three of the parathyroid glands often have been removed at previous operations.

At secondary operations it is well to remember that this distressing complication may be prevented if one stays high on the lateral capsule. Every effort should be made to identify the parathyroids.

Dodson[12] reported eight out of twelve cases of thyroiditis which later developed tetany following thyroidectomy.

This complication manifests itself within a few hours to two or three weeks later. As a rule, it occurs on the second or third postoperative day. The diagnosis is easily made by the carpopedal spasm or the patient may have an outright convulsion. Trousseau's and Chvostek's signs make the diagnosis when they are positive. Examination of the blood calcium will show it to be low. If there is any indication of parathyroid injury, treatment should be started early.

The best treatment is parathyroid extract followed by 5 to 10 cc. of 10 per cent solution of calcium chloride intravenously. If the tetany persists, 60 to 120 gr. of calcium lactate should be given every day along with cod liver oil. In the more difficult cases to control Pemberton and Stalker[13] believe that di-hydro-tachysteral (A.T. 10) along with calcium lactate is the best treatment. Vitamin D concentrate in doses of 50,000 to 150,000 units will also help the control if true tetany continues. Repeated blood calcium studies should be made.

As a rule these cases improve and frequently attacks will disappear entirely after a time. They often are completely relieved before the patient leaves the hospital as they are due to temporary interference with the blood supply or to edema.

*Cardiac Disabilities.* In elderly patients cardiac decompensation may be observed before and following surgery. These patients should be under the care of an able internist for a considerable length of time before coming to surgery. The standard measures, such as digitalis if necessary, should be fully employed.

Auricular fibrillation is a frequent complication especially in the nodular goiter patients. It rarely appears postoperatively in patients under forty years of age. This complication may be present before surgery is done or it may manifest itself following surgery. Quinidine and digitalis are the two stand-bys for those patients who show postoperative fibrillation. Many believe that quinidine should not be used until late in the postoperative period. It is their belief that the irregular rhythm will break of its own accord after the goiter is removed. Quinidine, however, carefully employed will usually break the rhythm back to normal.

*Minor Complaints.* Annoying cough and distressing mucus may be relieved by inhalations of steam cough mixtures, high fluid intake and intravenous glucose in plain water. If the patient is unable to take large amounts of fluids by mouth, 5 per cent intravenous glucose is indicated in all these cases.

Postoperative pneumonia is a very rare complication in goiter surgery. A patient should not go to surgery until any cold or sore throat is completely relieved.

*Wound Complications.* Angulation of the skin wound resulting from drainage may be disturbing for a time. If the patient will pull down on the scar daily, it will soon loosen and the angulation will disappear. The scar never should be revised before one year has elapsed.

If the patient is a keloid former, this history should be ascertained before the goiter operation. The scar should be treated early with x-ray. Patients who present themselves with keloid formations one year or so later, should have the scar removed and a very careful proximation made. Immediately following surgery, that is a few days later, x-ray therapy should be given to prevent any further keloid formation.

Serum in amounts from small to large is quite common especially after using catgut for ties. For several years I have used No. 40 to 80 cotton for ties with splendid results. Many of these patients will heal without any drainage. A few patients will

drain a small amount of serum for a number of days.

Infection very seldom complicates thyroid surgery. Hot sterile compresses will clear up the wound in a short time.

## SUMMARY

1. Proper preoperative care will avoid one of the most serious postoperative complications, namely postoperative crisis.

2. Careful, gentle surgery will prevent hemorrhage and injury to recurrent nerves or parathyroid glands.

3. The problems following thyroid surgery are usually easily handled by diligent postoperative management.

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# CHRONIC ULCERATIVE COLITIS AND ASSOCIATED CARCINOMA*

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CHRONIC ulcerative colitis is a serious malady of which the exact etiology is not known and treatment is not of a precisely successful form. Fundamentally, it is a disease of youth with the peak of its age occurrence in the second, third and fourth decades. It is a chronically debilitating disease requiring long periods of hospitalization in its treatment and, save for the exceptional cases, reduces the patient to the status of semi-invalidism for the greater part of his remaining years.

Superimposed upon this picture of a disease are the serious complications which this disease is particularly apt to develop in its course of remissions and exacerbations: general debilitation, strictures, perforations, complete obstruction, polyposis and peritonitis. One of the less common complications encountered is that of carcinoma arising in the involved inflammatory area.

Bargen, Cromar and Dixon[1] discussed some very interesting findings which they believed were important in the relation between subclinical or clinical infections and early carcinoma in the large bowel. Minor inflammatory changes in the lymph follicles of the submucosa as evidenced by the so-called encapsulation or germinal center development in the follicles were the predisposing factor. These follicles by progressive enlargement ultimately rupture, allowing the epithelium to prolapse. Latta[2] has shown that epithelial cells in contact with lymphoid cells retain primitive characteristics. These epithelial cells may escape or be isolated in the loose connective tissue of the submucosa. A ring of follicle formation and contraction may produce the often noted flat adenomas. Hadfield[3] notes that large follicles are frequently seen in inflammatory lesions and the earliest changes consist of follicular enlargement and giant cell presence. So it is safe to assume that a potentially malignant region exists in the colon prior to and coincident with the development of carcinoma. Since the reactive change to inflammation is primarily in the mesoblastic tissue, the epithelial changes must be of a retrogressive nature unless full function and histology returns, a condition little apt to occur when extensive damage has been done as in chronic ulcerative colitis.

Brust and Bargen[4] suggest that the pathologic condition of this disease is such that as the small abscesses rupture there is a slough of the overlying mucosa, leaving relatively normal marginal mucosa which is piled up as pseudoprojections or pseudopolyps. The healing process proper may take either of two courses: true healing may occur with resultant pock-marked mucosa, thickening and contraction of the wall of the colon or complications may result with the formation of strictures, polypoid masses, adenomatous polyps and carcinoma. True adenomas may develop in the very late stage of healing, but this is a very rare occurrence. Frequently, the tips of these adenomas show poorly controlled growth with retention of secretions and collections of débris, "colitis polyposis cystica." These authors make an interesting deduction from their figures, showing an incidence that 2.5 per cent of 800 patients with chronic ulcerative colitis develop carcinoma. The United States Department of Commerce (1923 to 1929)

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states that 0.011 per cent of all the population die of carcinoma of the large bowel and rectum. This comparison certainly indicates the presence of a carcinogenic factor in chronic ulcerative colitis.

The malignancy which develops may be either of two general types: localized polypoid carcinoma or the diffuse carcinomatous involvement of almost the entire inflamed area. Irrespective of the type or location of the malignant process, it is well agreed by most observers that the prognosis is universally grave. Hurst,[5] alone, finds the general prognosis in ulcerative colitis to be not too alarming. He reports eighty-five cases of this disease without an observed incidence of carcinoma as a complication, with 77.6 per cent of the patients well and an additional 10.6 per cent not well but able to carry on their usual activity. David, Rankin, Bargen, Coffey and Dixon[6–11] are greatly impressed by the serious prognosis of the malignancy where it develops and uniformly urge a radical form of treatment. Bargen and Dixon[10] report twenty-seven cases of carcinoma complicating chronic ulcerative colitis. Four of the twenty-seven patients had diffuse carcinomatous involvement of the entire colitis area; five of the twenty-seven had multiple primaries. From their presented data it is possible to conclude that seven died in the period of initial operative treatment. A total of seventeen died altogether. These authors, as well as Rankin[7] and David,[6] advise excision of the entire colitis area in treatment of the malignancy. This is well established reasoning for in a report by Bargen[9] of 200 late chronic ulcerative colitis patients 13 per cent showed polyp or pseudopolyp formation. In this same series were twenty patients with the complication of carcinoma, of whom fifteen were operated upon and twelve died, seven of generalized peritonitis.

There seems to be general agreement among observers that polyp formation occurs with greatest frequency at the site of severest inflammation. The transition features a progression from inflammatory polyps to adenomatous polyps to carcinoma. The classification suggested by various authors[8,11] seems a very useful one and is based on clinicopathologic evidence: (1) Congenital adenomatosis (no relation to chronic ulcerative colitis). (2) Chronic ulcerative colitis with polyposis (pseudo-adenomatous polyps; adenomatous polyps which are very rare and similar to adenomas of multiple polyposis and carcinomatous polyps).

Coffey and Bargen[8] found the following incidence of the various types of polyps according to the classification just given. All the cases with polyp formation were classified:

| | Multiple Adenomatosis (Per cent) | Chronic Ulcerative Colitis with Polyposis (Per cent) |
|---|---|---|
| Pseudo-adenomatous..... | .... | 56.2 |
| Adenomatous polyps..... | 100 | 21.9 |
| Carcinomatous polyps.... | 62.5 | 21.9 |

Coffey[11] states that the incidence of pseudopolyposis in chronic ulcerative colitis is 10 per cent. Malignancy in chronic ulcerative colitis is 2.5 per cent and in 60 per cent of these cases of malignancy polyps were found.

Cabot case No. 25201[12] presents the usual history but the unusual feature was the roentgenographic picture which showed a normal rectum and transverse colon. The involved areas were the cecum, ascending colon, splenic flexure and descendens down to the rectosigmoid. The usual pseudopolyps were seen and an unusual type of plateau polyp. The treatment consisted of an ileosigmoidostomy with survival and great improvement.

Cabot case No. 19023[13] is of interest. The patient's age was fifty-nine years. The history was one of a low grade chronic ulcerative colitis for nearly the entire life of the patient. Roentgenogram of the colon

revealed multiple polyps throughout the colon and an ileostomy and total colectomy were done. The particular interest of this case was the pathologic examination of the surgical material. The findings of chronic ulcerative colitis were present; two types of polyp formation were found, consisting of adenomatous polyps with many areas borderline between adenoma and carcinoma and the other type of inflamed granulation tissue and pseudo-adenomatous polyps. In addition there was an almost complete sigmoid stricture on an inflammatory basis.

Matzner and Schaefer[14] report a case of a patient aged twenty-nine years who had been under treatment for chronic ulcerative colitis for seven years. There was a sudden change of symptoms, consisting of a mass in the abdomen, rapid progressive weight loss and a decrease in the number of daily bowel movements. The diagnosis was obstructing polypoid sigmoid carcinoma and far advanced chronic ulcerative colitis with polyposis. These same authors present their statistics over a twenty-year period in comparison with those of the Mayo Clinic. These will be shown at the end of this paper, with the additional cases from the University Hospital, Ann Arbor, Mich.

In a twelve-year registration period at the University of Michigan Hospital three patients with carcinoma complicating chronic ulcerative colitis were treated. This may not be a true picture since other patients with chronic ulcerative colitis may have developed malignancy with no information given to this institution. One case (Case 1) is so typical a course of the complicating disease that the case record is presented in some detail in connection with x-rays and pathologic tissue studies.

## CASE REPORTS

Case 1. E. L., Hospital No. 370896, aged twenty-one, was a white female. The original hospital admission was on October 22, 1935, with a history of diarrhea of eight years' duration, with stools eight to ten times per day. For the past two years the stools consisted of blood and mucus. The past year had resulted in a 20-pound weight loss.

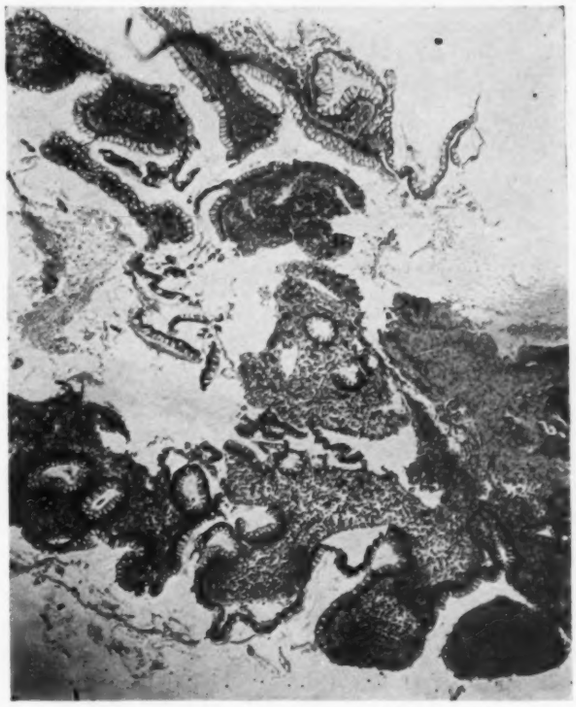

Fig. 1. Case 1, biopsy specimen obtained at the time of the first hospital admission which revealed typical findings of chronic ulcerative colitis.

The past history and systemic review were non-contributory except for two previous abdominal operations for a uterine tumor and a lysis of adhesions. Menstrual history gave the onset to be at seventeen years of age with periods occurring one to two times a year until nineteen years of age; then they were normal until two months prior to admittance to this hospital. At the time of admittance her periods occurred every two weeks with a four-day duration.

Physical examination was remarkably good with no evidence of a chronic debilitating disease.

Rectal and sigmoidoscopic examinations revealed numerous ulcerated areas in the lower colon with many bleeding points. The mucous membrane was covered with a grayish membrane which, when removed, left bleeding areas. There were many small granulating ulcers. Biopsy specimen confirmed the diagnosis (Fig. 1) of chronic ulcerative colitis. Barium enema studies (Fig. 2) showed typical findings of chronic ulcerative colitis with some involvement of the terminal ileum. Basal

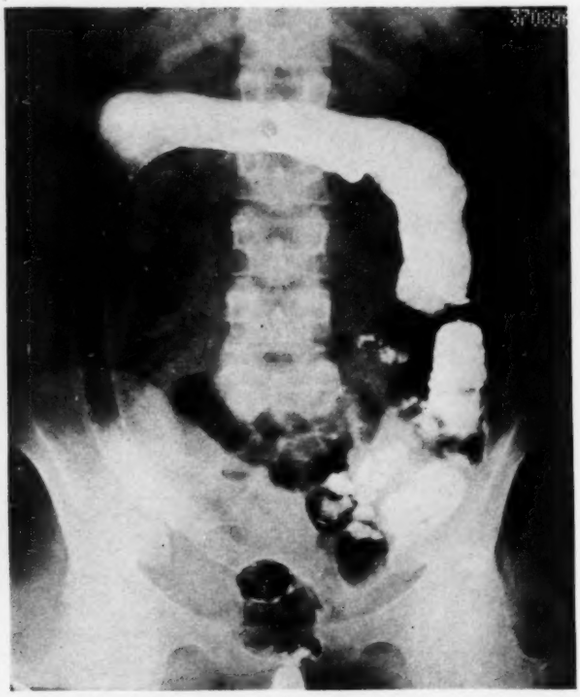

FIG. 2. Barium enema air injection studies at the time of the first admission revealing typical roentgenographic evidence of chronic ulcerative colitis, with some involvement of the terminal ileum.

metabolic rate was −18 per cent, with a pulse rate of 64. Complete stool studies revealed no specific pathogens. Hemoglobin was 80 per cent (Sahli).

The patient was treated actively on the medical service with no resultant improvement; surgical care was advised. During the period of medical management the patient ran a particularly febrile course. On December 18, 1935, an ileostomy was done. Aside from a rather severe wound infection, the postoperative course was quite uneventful; she was discharged on February 15, 1936.

She returned January 13, 1937, with no complaints; there was a weight gain of 10 pounds as well as a re-establishment of the normal menses with thyroid medication and resumption of her own housework. There was no stool or discharge from the rectum. The possibility of re-establishing the intestinal continuity at this time was considered. Sigmoidoscopic examination revealed no active ulcerations; the papillae were reddened and the mucosa injected. Barium enema revealed a very small ampulla. The entire colon was leadpencil in size and filled almost instantly. The opinion was that continuity could not be

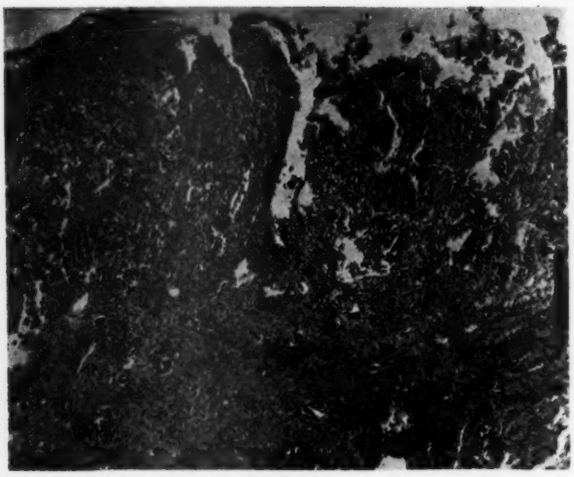

FIG. 3. Biopsy taken at the time of a check-up on March 16, 1939, showing medullary adenocarcinoma, grade III, infiltrating in the smooth muscle, adipose and connective tissue.

resumed at this time and she was discharged January 29, 1937.

The patient was repeatedly seen in the outpatient clinic where she appeared to be doing well. Barium enemas on June 2, 1937 and January 12, 1938 showed progressive colon narrowing and loss of haustration. Sigmoidoscopy on this latter date revealed a stricture at 9 cm. beyond which the scope could not be passed, but no malignancy appeared in the mucosa.

The patient returned March 16, 1939, stating that she had had no weight loss and felt very well. She had had the onset of a rectal discharge of blood and mucus in July, 1938. Sigmoidoscopy revealed the previously described constriction; the overlying rectal mucosa was ulcerated, red and granular with polypoid changes. A biopsy was reported as medullary adenocarcinoma, grade III, infiltrating in smooth muscle, adipose and connective tissue and extending along lymphatic channels in adipose tissue. (Fig. 3.) Barium enema revealed advanced chronic ulcerative colitis with minimal evidence of associated polyposis.

The patient was admitted and prepared for operation. On April 24, 1939, a one-stage combined abdominal perineal resection of the rectum, with a bilateral salpingo-oophorectomy was done. At the time of operation no gross metastases were found although there were many enlarged nodes in the relatively short mesosigmoid. Pathologic examination revealed a 30 cm. segment of large bowel which was markedly contracted and hose-like in appearance. Microscopic examination (Figs. 4A to D)

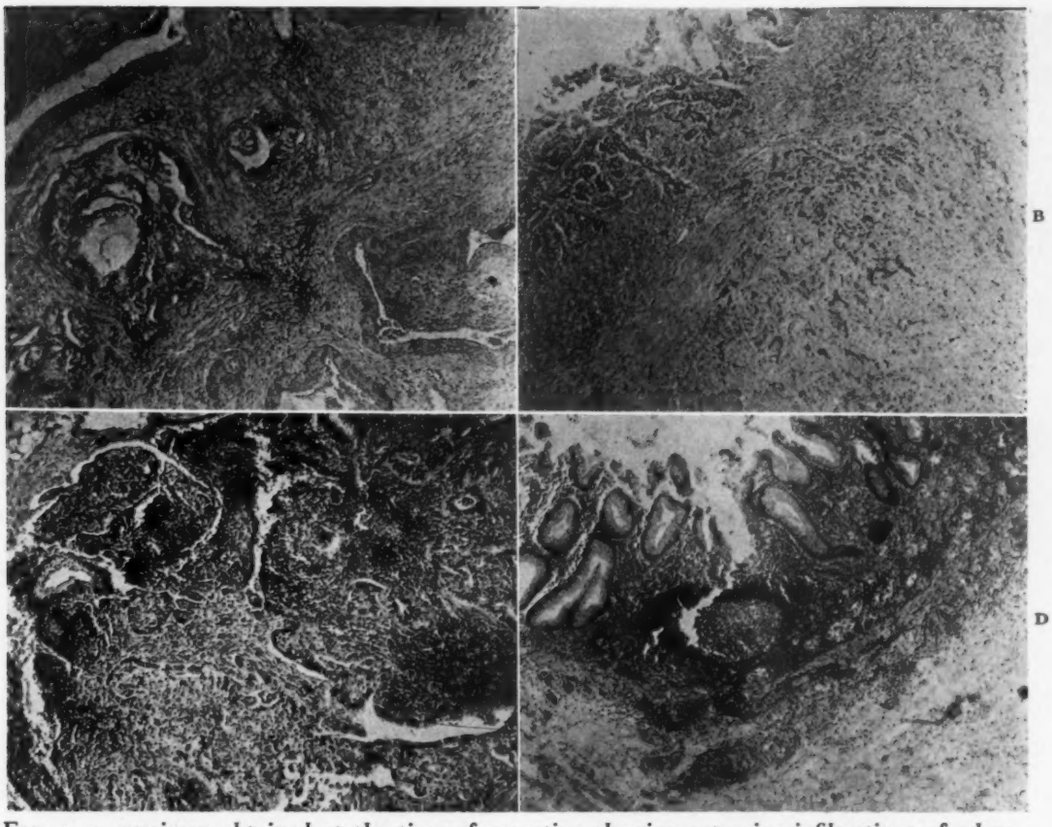


FIG. 4. A, specimen obtained at the time of operation showing extensive infiltrations of adenocarcinoma occurring in the large and small nests of the ovaries. B, Surgical specimen showing carcinomatous infiltrations in the Fallopian tubes. C, surgical specimen of an isolated lymph node showing extensive replacement by neoplastic tissue. D, section taken from the upper end of the resected large bowel showing extensive infiltrative metastases at the line of resection.

revealed extensive infiltrations of an adenocarcinoma, occurring in large and small nests in the ovaries. The Fallopian tubes showed carcinomatous infiltration. There was an adenocarcinoma, grade III, primary in the colon. Serial blocks taken along the length of the specimen showed widespread adenocarcinoma in the upper five-sixths.

In the lower remaining portion of the rectum there were changes of chronic ulcerative colitis with polyposis and carcinomatous invasion in a few of the lymphatics. Of one hundred lymph nodes isolated by the technic previously described by Coller, Kay and MacIntyre[15] seventy were largely replaced by carcinoma. The patient's postoperative course was uneventful and she was discharged on May 28, 1939.

On July 31, 1939, she returned because of severe pain in her lower back and right flank. X-ray examination of the spine revealed osteoclastic metasases in the right margin of the second lumbar vertebra. Palliative x-ray therapy was given and repeated on a re-admission on September 19, 1939. The patient went into shock on September 28, 1939, and remained so until death occurred two days later.

The autopsy examination was limited to the abdomen. The pathologic diagnoses were: subacute fibrinopurulent peritonitis, hydroperitoneum, metastatic carcinoma in the transverse colon, hepatic flexure, liver, spleen, adrenals, periportal, peripancreatic and inguinal nodes. There also was peritoneal carcinomatosis and metastatic carcinoma in the lumbar vertebral bodies. (Figs. 5A to C.)

CASE II. S. J. B., Hospital No. 473192, aged forty-seven, was a white male. There was a history of onset of dyspepsia, mild cramps and nervousness six months prior to admittance. Five to six weeks prior to admittance there was an episode of acute "intestinal flu," with four to five bowel movements a day, generalized abdominal cramps, distention and liquid stools; there was no melena. Subsequently, there was an alternating diarrhea and

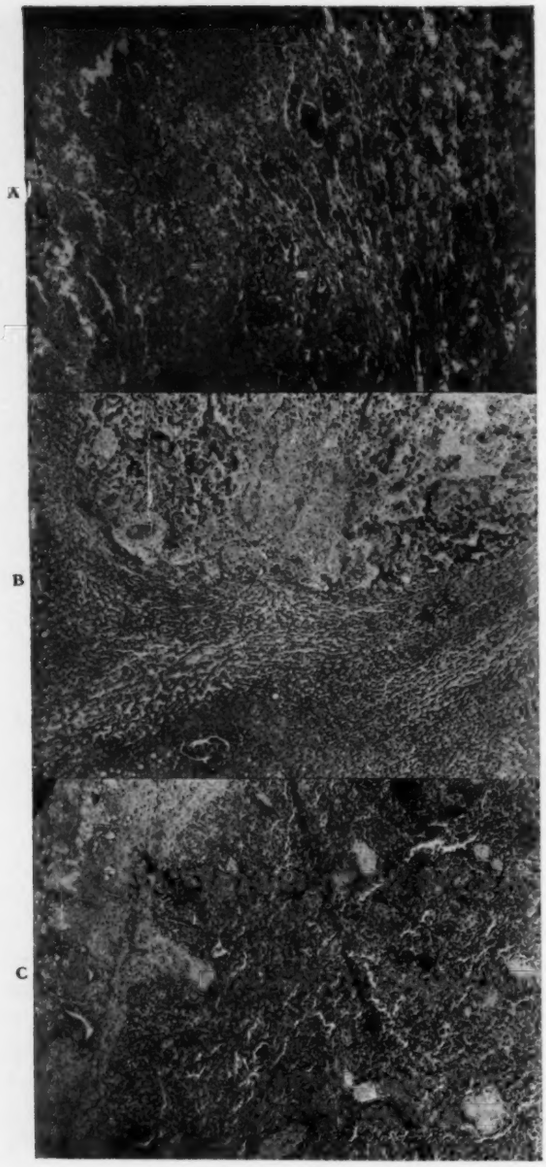

FIG. 5. A, autopsy specimen showing anemic infarction of the adrenal with neoplastic cell nests in the zona fasciculata. B, autopsy specimen showing large and small metastases and secondary degenerative changes in the liver. C, autopsy specimen showing the spleen with subacute peritonitis and metastatic neoplasm in the parenchyma.

constipation, changing every three to four days. Four weeks before a gastrointestinal x-ray and protoscopic examination done elsewhere were reported to be negative.

Physical examination revealed a pneumonic process of the right base. Abdominal examination showed distention but no masses or tenderness. X-ray and cholecystogram examinations showed a normal upper gastrointestinal tract. There was marked distention of the large bowel down to the sigmoid. Stool examination was positive for occult blood; white blood cells were 13,700 and hemoglobin was 70 per cent. The plasma chlorides were 459 mg. per cent and the non-protein nitrogen was 58.8 mg. per cent. An emergency cecostomy was done as a palliative measure but the patient succumbed.

Pathologic examination revealed an extremely severe process; the abdomen was distended and tympanitic, with an escape of gas upon opening; there was generalized peritonitis adherent at the sigmoid. The colon showed marked dilatation, discoloration and gangrene, with numerous areas of perforation in the transversus. Numerous transverse punched out ulcerations of the transverse colon were seen when it was opened. Ascendens and sigmoid were normal grossly. Distal to the ulcerations in the transverse colon was a 4 by 3 by 3 cm. intraluminal polypoid lesion with partial obstruction.

Microscopic examination revealed a necrotizing ulcerative colitis with gangreneous perforations. There was a slightly papilliferous adenocarcinoma, grade II.

CASE III. E. F. L., Hospital No. 267740, aged fifty, was a white male. There was the usual history of typical ulcerative colitis of moderate severity for ten years. Ten months prior to the present admittance there was an onset of progressive obstructive symptoms. A transverse colostomy was done at another hospital because of a sigmoid obstruction. At about the same time urinary frequency, urgency and dysuria occurred. In May, 1939 the patient experienced sudden abdominal pain and the passage of gas *per uretbram.*

Physical examination revealed the patient to be in a state of emaciation. The only specific finding was a hard, questionably extrarectal mass.

Roentgen examination revealed an obstructive lesion of the sigmoid. Cystoscopic examination revealed no fistulae or malignancy. Sigmoidoscopy showed no lesion of the mucosa but a definite mass was seen and felt as an encroachment on the lumen. Abdominal surgical exploration showed findings suggestive of chronic ulcerative colitis high in the mid-sigmoid and through the remainder of the sigmoid and rectum. No malignancy was seen.

The patient died on his fourth postoperative day of a pulmonary embolus.

Autopsy examination revealed right pulmonary infarction and typical findings of long-standing chronic ulcerative colitis. Beginning 12 cm. above the mucocutaneous junction and extending 14 cm. above that was a polypoid, ulcerating, hard lesion. The rectal wall was 3 cm. thick. There was numerous small "polypi," averaging 2 cm. proximal to the lesion. There were two perforations of the rectum into an abscess cavity of 200 cc. communicating with the bladder and sigmoid lumina.

Microscopic examination diagnosed an adenocarcinoma, grade II, of the rectum, bladder and adjacent tissue. It is interesting that the thickening of the rectal wall was both on an inflammatory and a neoplastic basis.

COMMENTS

Case III was of interest because of the three pathologic complications of chronic ulcerative colitis: polypoid degeneration, perforation and malignancy. All three of these cases present the typical history and findings of chronic ulcerative colitis, with a sudden change in symptoms which marked the onset undoubtedly of clinical malignancy although the irreparable damage was wrought at an earlier time. The 100 per cent mortality in this small number of cases only adds additional statistics to the already accepted fact of the almost uniformly grave prognosis in a case of ulcerative colitis in which neoplasm is added as a complication. Adding the information to the facts quoted by Matzner and Schaefer[14] the results are:

| | Mayo Clinic | Jewish Hospital | University of Michigan |
|---|---|---|---|
| Total cases of ulcerative colitis.. | 800 | 185 | 451 |
| Per cent of carcinoma in total cases of ulcerative colitis..... | 2.5 | 1.6 | 0.7 |
| Per cent of carcinoma of large intestine of all admissions..... | 0.88 | 0.5 | 0.3 |

While there is considerable discrepancy in the incidence statistics, it must be remembered that the cases of malignancy complicating chronic ulcerative colitis are relatively rare. It is noteworthy that in all three quotations just stated there is general agreement that carcinoma of the large bowel and rectum occurs approximately two to three times as frequently in patients with chronic ulcerative colitis as it does in a sampled unselected number of hospital admittances. This, again, only further augments the statement of Brust and Bargen[4] that there is a definite carcinogenic process present in chronic ulcerative colitis. This process must be assumed to be the inflammatory process fundamentally for from it arises the pseudopolyps or inflammatory polyps, the true adenomas or the metaplastic regenerating mucosal tissue which may become isolated deep in the reparative mesoblastic structure producing the described, diffusely infiltrating malignancy which is undistinguishable grossly from the mural thickening subsequent to healing in the disease.

The evident failure throughout all the literature of resection procedures for malignancy, leaving part of the diseased bowel, stresses the importance of complete removal of all the bowel involved in ulcerative colitis. This consideration undoubtedly will decrease the deaths from peritonitis and will avoid the presence of residual diffuse carcinoma in the remaining submucosa which is practically impossible to differentiate grossly from the late stages of chronic ulcerative colitis.

Patients with a history of chronic ulcerative colitis, even though progressing well on a medical regimen, must be repeatedly and carefully examined by barium enema and sigmoidoscopy for evidence of polyp formation. The rare case in which an ileosigmoidostomy or ileorectostomy is done since the lower colon was spared in the disease must be constantly considered a source of irremediable damage because of the mere presence of that section of large bowel. It even might be a safer procedure to consider a total colectomy in all cases of ileostomy for chronic ulcerative

colitis in which a rapid improvement in the rested colon has not occurred and that without polyp formation.

Constant vigilance is the rule in this disease, a disease which in its own course is debilitating and incapacitating with a significant mortality rate. To these facts is added the extremely serious circumstance that patients with this disease are two to three times as liable to develop a malignancy.

SUMMARY

A review of the literature on carcinoma complicating chronic ulcerative colitis is presented with the opinions and recommendations of many observers in respect to management and prognosis.

Three cases are presented somewhat in detail with illustrative x-rays and microscopic material.

A general discussion of the diseases is presented.

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# MESENTERIC CYSTS

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THE occurrence of a mesenteric cyst was first recorded during the year 1507 when Beneviene, a Florentine anatomist, reported one observed at autopsy. Rokitansky's[1] description of a chylous cyst in 1842 is generally accepted to be the first accurately recorded case history. The most complete historical records made in recent times are the fifty-two cases described by Friend[2] in 1912. These cases were supplemented to ninety-five cases by Benedict[3] in 1913. In 1932 Warfield[4] had reviewed 129 cases and added two more, estimating that there were probably 500 cases recorded in medical literature. Parsons[5] in 1936 also estimated that about 500 cases had been reported. Keesey[6] in 1938 estimated 400, and Slocum[7] 300.

Much of the difference in estimates is due to the inaccurate description of a mesenteric cyst. The term includes too broad a field and sometimes includes other mesenteric tumors with cystic characteristics. Before Dowd's[8] classification (1900) scientific information lacked accurate description, and there is no way of knowing the number of solid versus cystic tumors. This is one reason for Slocum's low estimate. A true mesenteric cyst, according to Roller,[9] is between the leaves of the mesentery, excluding retroperitoneal cysts and any that should be classed as malignant tumors. One universal point of agreement is that the condition is very rare. Statistics from large hospitals are adequate proof of its low incidence.

The early cases were reported from autopsies. In 1880 a case was recorded to be a successful operation. It was not until this century that recognition of this condition and successful treatment were scientifically instituted.

## ETIOLOGY AND CLASSIFICATION

Mesenteric cysts have been reported in individuals of every age from newborn infants to octogenarians; indications point toward greater frequency in early adulthood. The cysts are more prevalent in females than males. Friend collected data on fifty-two chylous cysts of the mesentery and found the occurrence covered all ages. The cysts varied all the way from 1 to 18 cm. in diameter. The usual location was in the umbilical region or between the umbilicus and pubes.

The etiology of these cysts is still obscure. In 1842 Rokitansky stated their origin to be from degenerated lymph nodes. Braquehaye[10] in 1892 and Moynihan[11] in 1897 classified mesenteric cysts according to their contents and suggested the etiology to be: (1) hemorrhage between mesenteric layers; (2) dilatation of lacteals or lymphatics; (3) degeneration of lymph glands. Noting the frequent occurrence in early childhood, Dowd in 1900 divided mesenteric cysts into classifications according to their origin: (1) embryonic (most common)—dermoid, serous, chylous, hemorrhagic, enteric; (2) hydatid; (3) cystic malignant disease.

Dowd substantiated this belief by tracing the embryology of the Wolffian body and the germinal epithelium aberrant identifying remnants which may become separated and carried into the mesentery and mesocolon there forming cysts. He also suggested that portions of the developing gut might likewise be displaced in the mesentery and later form an enterocyst.

Many writers since Dowd have amplified his classification and contributed additional theories as to the genesis of these cysts together with their own etiologic

classifications. Among these writers are Ayers[12] (1906), Niosi[13] (1907), Carter[14] (1921), Higgins and Lloyd[15] (1924), Ewing[16] (1928), Warfield[4] (1931), Snyder[17] (1938) and Roller[9] (1940). Of these Roller's is the most comprehensive while Snyder's seems the most practical. The following is Snyder's classification: (1) Simple cysts (containing clear serous fluid with or without lining membrane); (2) chylous cysts (similar to that just mentioned but containing chyle), (3) cystic dermoids and teratomas; (4) enterocystomas (containing muscular tissue and mucosa similar to the intestine); (5) parasitic cysts (hydatid or echinococcus).

It can be seen from the foregoing that there is no unanimity of opinion as to the genesis of these cysts or a satisfactory classification. Until further research brings to light the true etiology of these cysts, it is concluded that only those found between the leaves of the mesentery should be classified as true mesenteric cysts.

## PATHOLOGY

Although most mesenteric cysts are single, they may be multilocular masses. Their sizes vary from those too small to palpate to those large enough to fill the abdomen. The most common site is in the mesentery of the jejunum or ilium, occasionally in the transverse mesocolon. The cysts lie between the leaves of the mesentery and are located anywhere between the enteric border to its base. They may be dumb-bell-shaped or spherical, depending on the projection of either mesenteric layer. Occasionally they surround the wall of the intestine, causing obstruction or strangulation of the adjoining loops. The cyst wall is usually thin and lined with epithelial cells. When the cyst is very large, the wall is so thinned by the pressure of its contents that its epithelial lining is lost and the wall is composed of fibrous tissue. Malignant degeneration is rare, and when it does occur it may be either carcinoma or sarcoma. The contents may be chyle, serous fluid, clear or cloudy or blood.

## SYMPTOMS AND DIAGNOSIS

Preoperative diagnosis of mesenteric cyst is still rare, partly because textbooks seldom mention the subject and also because there are no sure and indubitable pathognomic signs or symptoms. All writers agree that few mesenteric cysts will be diagnosed before operation.

The variance in size has already been mentioned. Two outstanding characteristics are the great mobility of the tumors in a transverse direction, and also the presence of intermittent pain of greater severity than is common with other abdominal cystic tumors. The pain is due to torsion, pressure and to a reduction in the caliber of the intestinal lumen. If the cyst is large, a fluid wave may be detected. Complications are usually present, including: intestinal obstruction; vomiting; alternate diarrhea and constipation; a change in weight, either an increase or decrease.[4]

Moynihan emphasizes that another factor in diagnosis is the presence of a zone of resonance around the cyst and a belt of resonance across it. Deaver[18] warns of the possibility of mistaking mesenteric for ovarian cysts. To avoid this he advises ascertaining if the tumor has grown from the abdomen toward the pelvis or vice versa, whether there is an inferior zone of resonance and whether both ovaries are independent of the tumor.

Mesenteric cysts should be considered in the differential diagnosis, the final diagnosis depending on elimination of other possible and more common conditions. These pathologic conditions should include: (1) retroperitoneal tumors; (2) ovarian cyst; (3) pancreatic cyst; (4) neoplasm of the bowel; (5) pedunculated fibroids of the uterus; (6) hydronephrosis; (7) movable kidney; (8) hydrops of the gallbladder; (9) omental cyst; (10) splenic tumor and (11) pregnancy.

Roentgenographic studies should be made in all cases in the process of exclu-

sion. X-ray can show the relationship of the tumor to the lumen of the bowel and the amount of narrowing from pressure.[14] An enema of barium sulfate can help in ruling out any involvement of the colon. Screening of the stomach may show a pressure defect. After barium palpation under a screen, with particular attention to the indentation and mobility of the viscera, is also helpful.[19] Pneumoperitoneum with screening or with the roentgenogram has been suggested by Flynn[20] for aid in determining the presence and location of the cyst.

### TREATMENT

The treatment of mesenteric cyst is surgical. Enucleation is the procedure of choice whenever it can be carried out without serious impairment of the vascular supply to the bowel. When enucleation is not feasible, resection accompanied by removal of a portion of the bowel and anastomosis must be employed. This is often necessary in the presence of an acute intestinal obstruction with a gangrenous bowel. Marsupialization is obsolete, except in the very unusual case in which nothing else can be done. Aspiration is unsatisfactory as a means of treatment and has its place only to reduce the size of the cyst preparatory to removal.

### PROGNOSIS

The diagnosis of this condition is usually not made preparatory to surgery and most surgeons in encountering it have never seen it before. Of the ninety-six patient's cases discussed by Benedict sixty recovered, fourteen died postoperatively, twelve were diagnosed at necropsy and results were not stated in the other ten. Infection is not a danger to be encountered in mesenteric cyst, but extensive adhesions or long-standing intestinal obstruction can be complications. Rupture of the cyst is a possible complication but a rare one as indicated by Eliason and North[21] when in 1935 they reported a case of ruptured mesenteric cyst which they believed to be only the third such found at operation. Atchley[22] estimates the mortality of mesenteric cyst at 35 per cent, Warfield at 20 per cent.

### CASE REPORT

M. J. D., a white female aged fifty-four, a secretary, was admitted to the Queen of Angels Hospital February 23, 1947, complaining of gradual loss of strength and a loss in weight of 15 pounds in six months. There was increasing constipation and intermittent colicky pain in the upper abdomen. Her appetite was poor and her digestion was fair; there was some nausea and vomiting; there was no blood or pus in the stools. The symptoms had begun about six months previously.

Her past history revealed a Cesarean section performed in 1919, a pan-hysterectomy performed in 1931 which had been diagnosed as fibromyomas uteri and in 1932 an appendectomy with resection of the terminal ilium; the cause was unknown. The patient had been under treatment for hypertensive heart disease for over five years.

The physical examination revealed the patient to be fairly well nourished; her facial expression and color were good. Examination was essentially negative except for the abdomen. A dimpled midline scar, 8 inches long, extended from the umbilicus to the symphysis pubis. Just above the umbilicus a round, firm, tender mass could be palpated. Upon physical examination, this mass was found to be movable and could be pushed from side to side or higher up in the abdomen.

Roentgenographic examination revealed a homogeneous density in the upper abdomen, 8 cm. in diameter, mobile and separate from the gallbladder, kidneys and gastrointestinal tract. Preoperative diagnosis was intra-abdominal tumor, probably mesenteric cyst. Omental cyst was excluded in the differential diagnosis due to the fact that the tumor could not be displaced downward.

On March 6, 1947, under spinal anesthesia, celiotomy was performed through a right rectus incision. A round, smooth cystic mass was located between the leaves of the mesentery 24 cm. distal to the ligament of Treitz. The tumor mass, although not a part of the bowel wall, was closely adjacent and involved its blood supply. The tumor was delivered, accurately packed and 24 cm. of jejunum and

FIG. 1. Gross specimen (author's case) showing actual size in cm., together with resected jejunum. Note close approximation to bowel wall.

FIG. 2. Gross specimen of cyst (author's case) on cut section. Note the thin fibrous wall and the contents which are light brown, partly gray, opaque, fatty, granular, pasty, semisolid material.

its mesentery resected, followed by an end-to-end anastomosis. The patient made an uneventful recovery and left the hospital in fifteen days. The pathologist's report revealed the specimen to consist of a resected segment of small intestine measuring 24 cm. in length; attached to it was a triangular-shaped mesentery. Protruding from one surface of the attached portion of mesentery and displacing one of the flat layers which was smooth and intact over it, there was a large, spherical cystic mass measuring 8.5 cm. in diameter. There were no gross abnormalities in the resected segment of small intestine. The wall of the cyst was thin and fibrous and it varied between less than 0.5 and 1 mm. in thickness. The cyst contained partly light brown and partly gray, opaque, fatty, granular, pasty, semi-solid material. The lining surface was smooth, partly trabeculated and there were a few scattered, irregular, light brown patches. (Figs. 1 and 2.)

Microscopic examination of the cyst wall showed it to be made up of dense, fibrous, partly hyalinized connective tissue. On the lining aspect there was an irregular layer of macrophages, some of which contained hematogenous pigment. Others had abundant vacuolated cytoplasm suggestive of lipoid content. On the external aspect there was some compressed fatty tissue outside of which moderately thickened serosa was seen. In one of the sections a small, well preserved lymphnode was found attached to the external aspect of the cyst. There was no evidence of malignancy. Diagnosis was benign mesenteric cyst.

## SUMMARY AND CONCLUSIONS

1. A case of mesenteric cyst in a female aged fifty-four is reported. The history in this instance was one of recurring attacks of abdominal pain and distention over a period of six months. A round, smooth, tender, movable tumor mass was detected on examination. By means of elimination of other possible and more common conditions a correct preoperative diagnosis of mesenteric cyst was made. Treatment consisted of resection of the involved bowel and cyst employing an end-to-end suture anastomosis. The patient recovered.

2. Differences of opinion in regard to classification of these cysts is due to their obscure etiology. Some believe them to have a multiple origin and therefore have classified them according to their physical properties while others state definitely that they are embryonic in origin and have classified them on this basis. The case herein reported is believed to be one of true mesenteric cyst arising from mesodermal remnants.

3. Mesenteric cysts, especially the chylous type, are fairly rare. These cysts should be more frequently considered in the differential diagnosis of abdominal tumors.

4. The treatment is surgical and consists of removal by that technic which seems best adapted to the particular case after it has been studied through the open

abdomen. Procedure in the order of desirability is as follows: (1) enucleation; (2) extirpation with removal of the involved mesentery and adjacent bowel followed by anastomosis; (3) marsupialization; (4) aspiration.

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# Case Reports

## MEDIASTINAL LIPOMA WITH INCLUSION OF REMNANTS OF THYMUS GLAND*

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IN a review of the literature the authors have been able to find only forty-seven cases of mediastinal lipoma reported. Heuer[1] collected thirty cases from the literature and added one of his own. In a collective review on mediastinal tumors Heuer and Andrus[2] brought the total number of cases up to forty-two. Recently Watson and Urban[3] and Blades[4] have reported cases making a total of forty-seven. Since this lesion is uncommon and offers difficulty in diagnosis, the authors wish to report a case of mediastinal lipoma in which the remnants of the thymus gland were incorporated within the tumor.

### DIAGNOSIS AND TREATMENT

In thoracic lipoma the symptoms may be extremely mild or quite marked and usually bear no direct relationship to the size of the tumor. One may obtain a history of progressive dyspnea, orthopnea or only a feeling of intrathoracic oppression. A non-productive cough may be an early symptom. Pain is usually a late finding. The physical findings are not characteristic and will depend upon the size and location of the lesion. Occasionally a mistaken diagnosis of fluid in the pleural cavity is made and aspiration is attempted. In such a case no fluid will be obtained; however, a sensation of entering a buttery or boggy substance is experienced.

Two clinical types of thoracic lipomas are recognized, namely, those that are entirely intrathoracic and those that are intrathoracic with an extrathoracic extension. In the latter the correct diagnosis is more likely to be made. It is in the intrathoracic type that some difficulty is met with since the symptoms produced by such a lesion are similar to those encountered with other types of mediastinal tumors. The most common location is in the cardiophrenic angle.

Roentgen examination of the chest usually shows a well defined mass that may limit itself to the mediastinum. However, the entire pleural cavity may be occupied. The true nature of the mass may be suspected by the homogenous density with the periphery being less opaque.

With the recent advances in pre- and postoperative care, endotracheal positive pressure anesthesia and surgical technic, these lesions should be treated surgically since there is danger of the tumor causing compression of vital structures or undergoing malignant changes. X-ray therapy has no place in the treatment of this condition. A total removal in one stage is preferable. However, in certain circumstances a two-stage procedure may be necessary as in the involvement of both sides of the thoracic cavity.

### CASE REPORT

CASE 1. R. N., No. B 95689, a thirty-five year old, white, married female was seen in the out-patient department on December 9,

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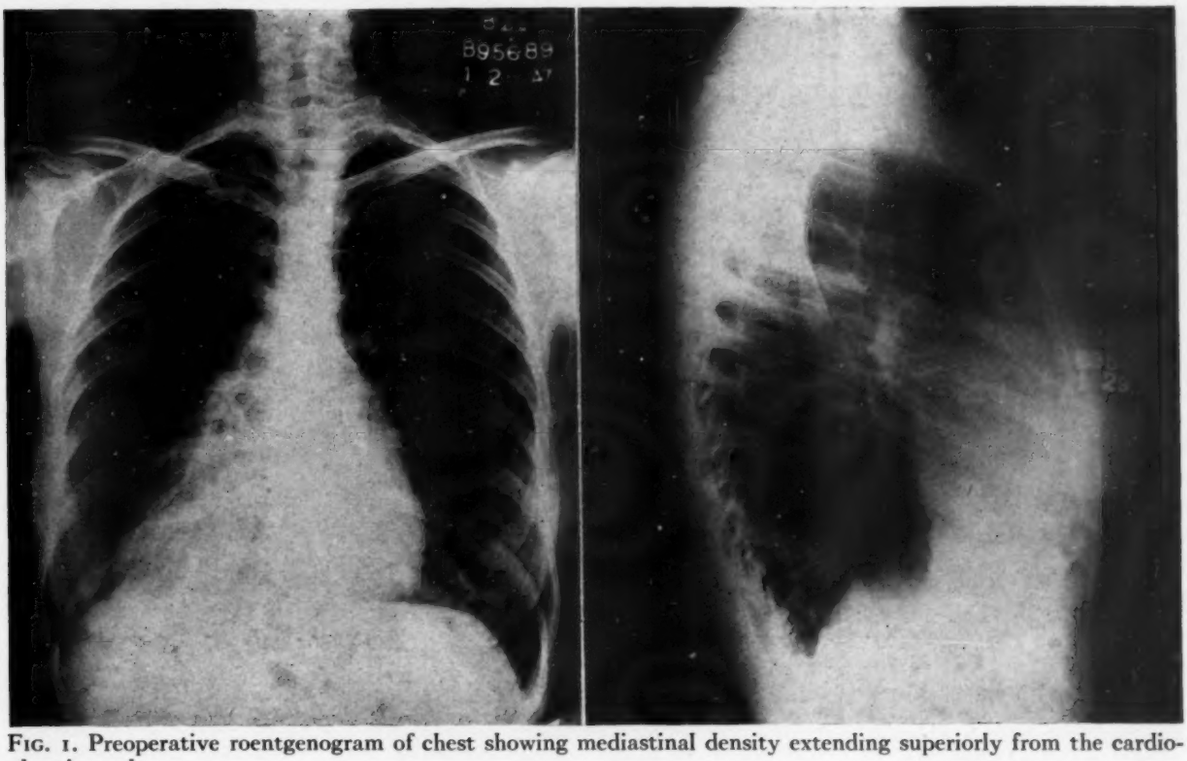

FIG. 1. Preoperative roentgenogram of chest showing mediastinal density extending superiorly from the cardiophrenic angle.

1946, complaining of exertional dyspnea and occasional wheezing. Approximately ten years previously, following a routine fluoroscopic examination of the chest, a mass was noted in the mediastinum. A diagnosis of "enlarged right side of the heart" was made. She was asymptomatic except for mild exertional dyspnea. About five years ago she developed marked orthopnea and required five pillows for relief. She noted that she could sleep lying flat on her left side without dyspnea or orthopnea. Four years ago she had malaise, easy fatiguability, nausea and vomiting. X-rays of the chest again showed the tumor mass previously noted. Hospitalization and operation were advised but were refused at this time. She improved with symptomatic treatment except for exertional dyspnea. Four months prior to admission she noted expiratory wheezing and she developed a non-productive cough; dyspnea became more marked. She gave no history of productive cough, hemoptysis or chest pain. X-rays made on her clinic visit revealed a mediastinal tumor mass on the right. She was hospitalized on January 27, 1947.

Physical examination revealed a normal temperature, pulse and respiration. Her blood pressure was 120/78. The patient appeared to be well developed, well nourished and in no obvious respiratory distress. There were no cervical masses or distention of the neck veins. Examination of the chest showed equal and good expansion bilaterally. Tactile fremitus was slightly increased over the lower middorsal region of the right chest; percussion note was resonant. The inferior mediastinum anteriorly on the right was about 5 cm. wider than normal. Lateral to this area breath sounds were bronchovesicular with many squeaky rales.

Laboratory findings were hemoglobin, 15.5 Gm.; white blood cells, 15,880 with an essentially normal differential blood count. Serology tests for syphilis were negative; urinalysis showed no abnormalities. Blood chemistry studies were all within normal limits. Roentgenograms and fluoroscopy of the chest showed a large, dense, homogeneous shadow lying anterior and lateral to the heart on the right side. (Figs. 1 and 2.) The superior mediastinal shadow was not enlarged. The periphery of the mass was less dense than the central portion and it did not pulsate. The electrocardiogram was normal. Vital capacity was 2,800 cc. in 15 seconds. The resting minute ventilation was 12.6 L. with the maximum minute ventilation being 33 L. at 33 per cent of the vital capacity.

Bronchoscopy revealed only moderate thick-

FIG. 2. Postoperative roentgenogram of chest.

FIG. 3. Illustration showing lesion encountered at operation.

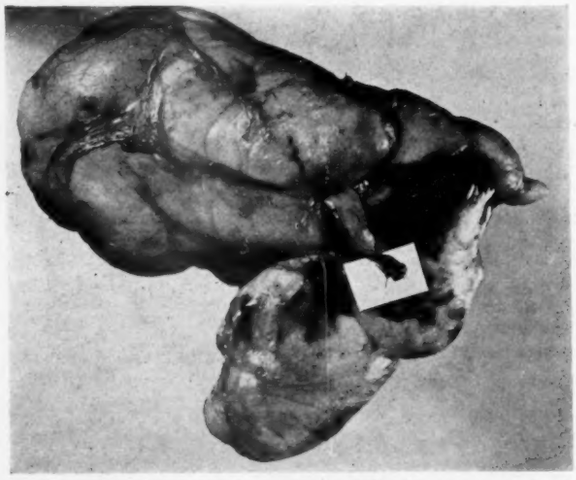

FIG. 4. Photograph of specimen. The lipoma weighed 625 Gm. Remnants of fibrotic thymus tissue were found incorporated within its substances.

ening of the carina between the right middle and lower lobes. A diagnosis of mediastinal lipoma and chronic obstructive emphysema was made. On February 3, 1947, an operation was carried out by one of us (G. B. H.) under endotracheal ethylene-oxygen-ether anesthesia. A right posterolateral thoracotomy incision was made in the sixth interspace. A large mediastinal lipoma was found which shelled out easily. The tumor extended from the cardiophrenic angle over the surface of the pericardium and base of the heart (Fig. 3) to the anterosuperior mediastinum where a small pedicle was found about 4 cm. above the arch of the aorta. It descended inferiorly on the left side of the heart for a short distance. The lipoma weighed 625 Gm. (Fig. 4) and measured approximately 24 by 19 by 8 cm. Microscopic examination showed a typical lipoma and in the

more central portion of the tumor remnants of fibrotic thymus tissue were found. The patient had an uneventful postoperative course. Ventilation studies showed no significant changes. The patient improved and was discharged from the hospital on the tenth postoperative day.

SUMMARY

We have been able to find only forty-seven cases of mediastinal lipoma in the literature. Successful operative removal of these lesions has been performed only in recent years. The diagnosis usually can be suspected from the roentgenogram. Early removal is recommended since these tumors may attain an enormous size and encroach upon vital structures or undergo a malignant change.

An additional case of mediastinal lipoma with remnants of thymus tissue is reported in which the diagnosis was made preoperatively and a successful, complete extirpation was performed.

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# AMEBIASIS*

## CONSIDERATION OF ITS SURGICAL ASPECTS AND TREATMENT

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PREVIOUS to World War II the incidence of human infection with Endameba histolytica in the United States was well over 10 per cent. Craig[1] stated that 30 to 40 per cent of the people in some communities harbored these parasites. Craig and Faust[2] estimated the total population involved to be over 13,000,000. Ochsner and DeBakey[3] computed the potential number of hepatic complications alone from E. histolytica to be approximately 300,000 to 600,000 which they considered represented only one-half of the existent surgically significant complications.

To these figures must now be added those cases which have developed during and after World War II. Since thousands of our men and women served in tropical and subtropical areas in which they were subjected to the hygienic hazards of war zone living, it is reasonable to assume many of them became infected with E. histolytica. Therefore, it seems timely to call attention to the frequency with which amebiasis may be encountered and to the importance of recognizing the bizarre symptoms which it may produce.

A generally accepted classification of amebic lesions which are of surgical significance is as follows:

I. Intestinal Lesions—(1) appendicitis; (2) perforation with resulting peritonitis; (3) massive hemorrhage; (4) "ameboma" (Amebic granuloma); (5) cicatricial stenosis; (6) pseudopolyposis.

II. Extra-intestinal Lesions—(1) hepatic abscess; (2) pleuropulmonary affections; (3) cerebral abscess; (4) cutaneous ulceration and abscess; (5) splenic abscess; (6) genitourinary affections.

Pathologic findings in amebiasis are characteristic and result from two types of action on the part of the invading protozoa: By mechanical action the pseudopods invade the tissues and by toxic action the host is effected both locally and generally. Three types of lesions are commonly seen: (1) shallow ulcerations, (2) diffuse granulations with ulcerations and (3) sharply circumscribed nodular projections between which are depressed yellow openings leading to gelatinous cavities. According to Strong,[4] human infection occurs only as a result of the ingestion of cysts which undergo development in the intestine and give rise to small trophozoites which attach themselves to the epithelium of the large bowel. Rapid penetration of the intestinal mucosa with entrance of the organisms into the submucosa lead to formation of small gelatinous necrotic areas or abscesses. Rupture of these abscesses causes ulcers and may be followed by secondary bacterial invasion. The most characteristic gross change is hyperemia and thickening of the wall of the large bowel. While all coats may become involved, the process is most extensive in the submucosa. Stasis of the fecal flow favors development of amebic lesions; consequently, the cecum, appendix, rectum and sigmoid colon are more frequently involved than the transverse colon. For instance, Faust[5] found at autopsy 33.3 per cent of the lesions to be in the cecum, 32.1 per cent in the appendix, 15.6 per cent in the rectum, and 12.8 per cent in the sigmoid while only 4.4 per cent occurred in the transverse colon.

Amebic lesions of the appendix, both the acute and chronic forms, may be

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extremely difficult to diagnose because the clinical symptoms are frequently not distinguishable from those caused by bacterial infections. Pain and tenderness over McBurney's point are the most common symptoms and in the absence of diarrhea, which occurs in the vast majority of cases, diagnosis may easily be missed. These points are illustrated in the following case reports:

### CASE REPORTS

CASE I. Mr. S. W., aged twenty-five, an infantryman who served in New Guinea, entered the hospital with a history of an attack of severe pain over the entire abdomen, nausea, vomiting and tenderness in the right lower quadrant. This had begun four weeks previously and lasted three days. Diagnosis of appendicitis had been made but operation was deferred because the process was considered to be subsiding. Twelve hours before admission he had had a similar attack and again a diagnosis of appendicitis was made by another doctor. During the interval between attacks his bowels had moved once a day and he could recall no episodes of diarrhea. On examination a definitely localized area of tenderness was found in the right lower quadrant. There was slight muscle spasticity but no mass could be palpated. His temperature was 98.8°F. and the leukocyte count was 14,000; sixty-four per cent of the white cells were polymorphonuclear leukocytes. Treatment was conservative. During the following week on six consecutive days soft-formed stools revealed no amebae, cysts, blood or pus. Cultures proved positive for E. histolytica. A course of antiamebic treatment was given and the patient made a rapid and uneventful recovery.

CASE II. Miss J. B., aged twenty-two, a world wide traveler, entered the hospital with complaints of abdominal cramps and tenderness in the right lower quadrant. The cramps and tenderness had persisted since an attack of diarrhea a week previously and had lasted three or four days. Her temperature varied from normal to 102°F. during that time; admission leukocyte count was 20,000. The urine disclosed negative results and two stool examinations made previous to entrance failed to reveal the presence of amebae. On examination marked tenderness with some rigidity was found in the right lower quadrant of the abdomen. No mass could be palpated; pelvic examination was negative. A diagnosis of appendicitis with spreading peritonitis was made and a laparotomy was performed. The peritoneum was found to be injected and edematous and a distended, dark red cecum with a thickened leather-like wall bulged through the incision. Considerable difficulty was encountered in removal of a retrocecal appendix. Emetine therapy was started immediately on the basis of pathologic findings and cultures taken from the removed appendix showed amebae to be present. Five days later the patient died of generalized peritonitis.

Appendectomy in the presence of an amebic infection of the bowel carries a high mortality and the outcome just mentioned is not an unusual one. Edema and thickening of the bowel wall make suturing and invagination of the appendiceal stump a dangerous procedure. Perforation of the bowel is likely to occur at the time of surgery or at a later date, resulting in gross contamination of the peritoneal cavity. Recognition of amebiasis as the underlying essential manifestation of appendicitis will save many lives. Treatment is not operative. With the proper use of amebacides which are non-irritating to the bowel, spontaneous rupture rarely occurs.

Fortunately, perforation of the bowel does not often occur. The symptoms it produces are those of local or generalized peritonitis. Usually a severe form of amebiasis precedes perforation. Treatment with amebacides is conservative and the patient is carefully observed. Should an abscess develop drainage must be established to prevent rupture of the abscess into the abdominal cavity. Prognosis in these patients is not good.

Another complication seldom seen which may arise in fulminating amebiasis is massive hemorrhage from the bowel. Here again the treatment is conservative. Amebacides are used and blood transfusions are given as indicated by blood loss. Prognosis as would be expected is bad.

Amebic granuloma or ameboma, as defined by Ochsner and DeBakey, is a tumefaction of the bowel wall which follows repeated invasions of amebae and is the result of progressive destruction and replacement of bowel tissue by fibrous tissue. Ameboma occurs most frequently in the region of the cecum or sigmoid as a firm, nodular, granulomatous, inflammatory mass and may present difficult problems in both diagnosis and treatment as illustrated by the following case report:

CASE III. Mr. J. N. aged twenty-five, was admitted to the hospital with a history of amebic dysentery occurring two years previously. This had been successfully treated, and he had been without symptoms until one month prior to the present time when he developed alternating diarrhea and constipation. Two weeks before entrance into the hospital generalized abdominal pain, cramping in character, caused him to consult his doctor. A course of vioform was taken although no amebae were found in the stools. Twenty-four hours previous to admission the abdominal cramps became increasingly severe, he became nauseated, vomited and noticed his abdomen rapidly "ballooning up." Examination revealed a uniformly distended abdomen with considerable borborygmus in the upper portion. No peristaltic waves could be seen. X-ray showed a stepladder arrangement of loops of distended small bowel. A napkin-ring deformity at the junction of the sigmoid and rectosigmoid suggested malignancy. No amebae were found in the stools, smears or cultures. Laparotomy revealed a markedly distended small bowel and colon as far distal as the sigmoid where an annular constriction approximately 2.5 cm. long was producing an acute obstruction. The appendix was the size of an index finger, the colon friable and injected. Obviously cecostomy was a difficult procedure. Postoperative recovery was uneventful except for several areas of ulceration which developed on the mucosa of the stoma. These were covered by grey membranes which bled readily and sloughed away at several points. Smears taken from these areas showed many amebae to be present. A series of emetine injections with local application of chiniofon resulted in rapid healing. Ten months later the patient's doctor reported him to be a well man.

Although the aforementioned patient probably has no carcinoma, there are in our records two case histories of patients with carcinoma of the large bowel and concurrent amebiasis. One of these patients was treated for a considerable time with amebacides before he was found to have an inoperable carcinoma. It is a well known fact that large amebic granulomas in patients of cancer age may be impossible to differentiate from malignancies. Recently Druckmann and Schorr[6] have called attention to eight salient points in the roentgenologic differentiation of amebic granuloma from malignant new growths of the large intestine. In amebic infections roentgenograms usually show the presence of a single extensive lesion with smaller defects adjacent. However, when no smaller adjacent lesions are present, differences in x-ray findings between amebiasis and carcinoma may be indistinguishable. Golden and Ducharme[7] state, "Carcinoma of the cecum usually produces an irregular asymmetrical filling defect associated with a palpable mass, whereas the deformity of amebiasis is smooth, regular and not associated with a palpable mass. A mass produced by a large amebic granuloma of the cecum cannot be differentiated from carcinoma." Numerous reports appear in the literature of instances in which colonic resections have been made following which the removed lesion proved to be of amebic rather than of carcinomatous origin.

Cicatricial stenosis is found most often in the region of the cecum or sigmoid although occasionally it occurs in the rectum. It is the result of repeated infections which cause a gradual replacement of normal bowel tissue by scar tissue. This takes place either in local areas or more rarely along the entire bowel. Surgery may become necessary for relief of partial or total obstruction, however, amebacides should always be given first. The following case history is typical of this form of complication:

CASE IV. Miss G. W. aged twenty-three, entered the hospital because of constipation

and pain on defecation. Six years previously she had developed diarrhea which lasted two years, and while her condition improved there had been many recurrences. Nine weeks before admission amebae were found in her stools and she was treated with emetine. Examination revealed an undernourished patient with moderate tenderness over the entire abdomen. Nine cm. from the anus a rectal stricture would admit only the tip of the examining finger. Stools contained blood, mucus and many amebae. Emetine was given and ten days later an ileostomy was performed from which the patient made an uneventful recovery.

Pseudopolyposis is rare and follows repeated amebic infections occurring over long periods of time. It may be confined to a localized area or extend along the entire course of the colon. Should hypertrophy of the mucosa become extensive enough to warrant surgical excision, a thorough course of medical treatment must be given prior to surgery.

*Extra-intestinal Lesions.* Of the lesions found outside the intestinal tract hepatic abscesses are the most common and of greatest importance. The frequency with which these occur has been estimated to be about 0.5 per cent in patients with clinical manifestations of the disease and 36 per cent in fatal cases. Over 80 per cent are found in males and the majority are in those between twenty and fifty years of age. Occurrence in patients from six to seventy years of age has been reported but very few in those under fifteen or over fifty. Trauma, exposure, starvation and alcoholism may act as predisposing factors by lowering the resistance of the liver.

Production of thrombi and infarcts, along with the digestive action of the amebae on the liver cells, play an important rôle in the development of liver abscesses. In the early stages only a small area of liquefaction necrosis may be present. The older, well developed abscess contains a thick, reddish-brown fluid or "chocolate sauce," which is composed of necrotic liver tissue and cells, leukocytes and blood. Seldom does it contain amebae and usually it is sterile. If secondary pyogenic infection has taken place, the fluid is somewhat yellow in color. Most amebic abscesses are single in contrast to the multiplicity of pyogenic abscesses although in severe fatal cases multiple abscesses are often found. The right lobe of the liver is more frequently involved than the left.

Pain, of a dull aching character beginning in the right upper quadrant or epigastrium and referred to the right shoulder, is a characteristic symptom. Later the pain may become piercing or stabbing especially if rupture of the abscess takes place. Usually the temperature is high in the early stages and follows a remittent course. In the chronic stage the temperature may be normal. Enlargement of the liver may be great enough to be visable. Tenderness accompanies the enlargement and usually there is decreased respiratory movement, muscle rigidity and dullness on the affected side. Anorexia, fatigue, weakness and loss of weight are not uncommonly present. The frequent absence of diarrhea may be somewhat misleading; and while these abscesses usually develop within two or three months after the initial infection of the colon, there are times when they may not appear for as much as forty years later. Examination of the blood shows a leukocytosis without a percentage increase in polymorphonuclears as seen in pyogenic infections. The highest count we have seen was 20,000, with an average below 15,000. While there is a definite increase in eosinophils, it is usually not marked. A slight secondary anemia is often present. X-ray findings are positive in over 80 per cent of cases and are characterized by an irregular liver surface outline, with a local bulging of the diaphragm at the site of the abscess. If rupture has occurred into the subphrenic space, the cardiophrenic angle is obliterated in the anteroposterior view and the anterior costophrenic angle in the lateral view. Most important to diagnosis is the finding of

E. histolytica in the stools or fluid from the abscess. Inability to demonstrate the parasites does not, however, preclude a diagnosis for in only 30 per cent of our patients have positive cultures been obtained. The complement fixation test of Craig is a valuable test and should not be overlooked.

Diagnosis usually is not difficult if the history, physical, x-ray and laboratory findings are properly evaluated while the possibility of a hepatic abscess is kept constantly in mind. Additional aids which have been employed in making or confirming a diagnosis are the diagnostic puncture and the peritoneoscope. Dangers accompanying their use are penetration of the pleural cavity, hemorrhage and spread of infection. Illustrative of some of the important features of hepatic abscess are the following case histories:

CASE V. Mr. T. S. aged forty-seven, entered the hospital because of persistent tenderness in the right upper quadrant, chills and fever. The tenderness had been present for six weeks as well as episodes of chills and fever of three week's duration. Onset had followed a heavy formal dinner which included cocktails and liqueurs. Sharp pains in both right and left upper quadrants accompanied each attack of chills and fever. No nausea or vomiting had occurred and all stools had appeared normal to him. He presented cholecystograms which showed no filling of the gallbladder. His doctor had diagnosed cholecystitis and recommended that surgery be performed. Upon examination the physical findings were essentially negative except for those of the abdomen. A smooth, firm, tender liver was palpable 3 fingerbreadths below the right costal margin. The left lobe was also enlarged but to a lesser degree. Proctoscopic examination revealed a normal rectal mucosa. Cultures taken proved positive for E. histolytica and small amounts of blood, mucus and pus were found in the stools.

Emetine therapy promptly eliminated his symptoms and enlargement of the liver rapidly subsided. The patient was at work again within a few weeks time.

Not so fortunate was the patient whose case history follows:

CASE VI. Mr. W. G. aged forty, was admitted to the hospital because of an acute upper respiratory infection of ten days' duration and abdominal pain in the right upper quadrant which began a few days after the onset of the cold. The abdominal pain was aggravated by deep breathing. Bowel movements had been regular, with no diarrhea at any time and apparently there was no relationship between bowel activity and his pain. Two years previously while serving in the European theater he had developed an abscess which was drained at the level of the twelfth rib on the right as evidenced by a healed operation scar. He was of the opinion that the liver had been involved. Otherwise his past history was negative and he had been in good health until the onset of his present symptoms. Upon examination the important findings were a few moist râles at the base of the right lung, slight epigastric tenderness and an enlarged, smooth, firm liver palpable 2 fingerbreadths below the right costal margin after deep inspiration. Proctoscopic examination revealed no abnormalities of the rectal mucosa. The temperature was 100°F. and the leukocyte count 16,000. Fluoroscopy showed a slightly limited motion of the right diaphragm but no irregularity of the surface could be demonstrated. There was no fluid in the pleural cavity. After repeated examinations E. histolytica cysts were identified in the stools. A course of emetine therapy was given and response was immediate. His abdominal pain and temperature subsided, appetite and weight increased and stools were negative for amebae. Six weeks later he developed another cold accompanied again by abdominal pain, chills and fever. A pleural friction rub could be heard on the right and a moderate degree of tenderness was present over the liver. While x-rays of the chest were being made, he experienced a sudden, severe, sharp pain which involved the entire right abdomen. Following this, the abdomen became rigid and bowel sounds diminished. At operation a large liver abscess which had ruptured into the peritoneal cavity was drained. Convalescence was satisfactory.

In the early stages of hepatic abscess when the process is simply an acute inflammation treatment is primarily medical and often a course of emetine is adequate. On the other hand, if a true abscess develops, surgical drainage then becomes

necessary. It should be emphasized, however, that if surgery is necessary the patient should be given preoperative emetine therapy unless rupture appears imminent. Lindskog and Walters[8] state that preoperative emetine reduces the mortality rates from 60 to 3 per cent. Long ago, surgeons experienced in the care of amebiasis adopted the closed method of drainage in preference to the open method for evacuation of these abscesses. As a result an amazing reduction in mortality occurred and since that time closed drainage has been the method of choice except in those cases in which secondary infection is present. Great care should be exercised in introducing the aspirating needle to avoid both the pleural and peritoneal cavities. Because of the viscosity of the contents of the abscess, a trocar is necessary at times instead of an aspirating needle. Although most of these abscesses are sterile, facilities for performing open drainage should always be available. Penicillin and the sulfonamides may be used to advantage if cultures reveal susceptible bacteria to be present.

Prognosis is greatly influenced by the presence or absence of secondary infection, various complications which have arisen, types of treatment which have been used and other factors. Ochsner and DeBakey found in 4,760 collected cases a mortality rate of 44.2 per cent following open operation in contrast to 6.7 per cent in patients treated by aspiration and amebacides. Complications increased the rate from 8.4 per cent to 39.4 per cent. Most frequent complications are perforation into the subphrenic space, pleuropulmonary involvement, embolic transmission to the brain and generalized peritonitis resulting from rupture into the abdominal cavity.

Pleuropulmonary amebiasis, which is next in frequency to hepatic abscess, may develop either by way of the blood stream or by direct extension from the liver. While the symptoms and findings vary with the type and extent of involvement, severe, persistent pain in the right lower chest radiating to the shoulders is usually present. This may be accompanied by a non-productive cough. The roentgenograms usually show a characteristic bulging or triangular shadow on the affected side. Should perforation develop a large amount of so-called "chocolate sauce" pus is expectorated. Following a new bronchohepatic fistula, amebae may be recovered from the sputum. We have seen only one case of bronchohepatic fistula, but in those reported the mortality has been high.

Cerebral amebiasis is rare and occurs usually in the presence of an overwhelming infection. Hepatic and pleuropulmonary complications frequently precede involvement of the brain and transmission is thought to be by way of the blood stream. Symptoms are those of a pyogenic abscess. The prognosis is bad.

Cutaneous amebiasis is very infrequent and has been classified into the following groups by Engman and Meleney:[9] (1) those following drainage of an amebic hepatic abscess; (2) those following drainage or rupture of an amebic intestinal lesion such as appendicocecal abscess, pericolic abscess, fecal fistula, colostomy or other operations upon the large bowel; (3) perianal extension of an amebic infection in the distal portion of the rectum; (4) primary cutaneous involvement in the absence of direct visceral connections. Treatment consists of emetine and radical excision plus restoration of depleted proteins and vitamins.

Splenic abscess and genito-urinary amebiasis are both rare forms of the disease. Usually the genito-urinary tract is involved secondary to an abscess in the liver. Lesions have been reported in the ovaries, tubes, cervix, vagina, testes, prostate, epididymis and penis. In all these conditions medical treatment is of primary importance.

SUMMARY

Amebiasis, a disease of wide, prewar distribution, has now assumed even greater importance. Over a million people in this

country have surgical complications. Amebiasis is of great importance to the surgeon because of its close similarity to other diseases, such as appendicitis, cholecystitis, carcinoma of the colon, perforated peptic ulcer and pancreatitis. Expert judgement and care are required for its successful management. Treatment is primarily medical and all surgical procedures should be preceded and accompanied by medical therapy. Unnecessary surgery in misdiagnosed patients invariably results in a high mortality.

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Today we have become cognizant of the importance and diagnostic value of finding tumor cells in various bodily secretions. No wonder, therefore, that chest specialists have begun to remind us of the importance of looking for cancer cells in the sputum of patients with suspected bronchogenic carcinoma. One recent authority found that by such cytologic examination the correct diagnosis could be made in approximately three-fourths of all such cases. One must look for abnormally large cells, hyperchromia, bizarre, abnormally large nuclei and especially for mitotic figures. All these diagnostic features help to point toward the correct diagnosis. This is true exclusively in the hands of experienced observers. Beginners are bound to make erroneous diagnoses. (*Richard A. Leonardo, M.D.*)

# SURGERY OF ILEAL TUMORS*

## REPORT OF A CASE OF INTUSSUSCEPTION LED BY LIPOMA OF THE ILEUM

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TUMORS of the small intestine are relatively uncommon and, of these, most are located in the ileal region. Raiford believes this to be due to the comparative freedom from stasis which exists in the small intestine.[1] He states that the terminal ileum is the only segment of the small intestine in which the fecal contents are retarded and accumulate before passing into the cecum. Stasis is believed to be one of the contributary causes of irritation which, in turn, is supposed to predispose to tumor formation, particularly of the malignant type.

Of Raiford's series of eighty-eight tumors of the small intestine, derived from examination of 11,500 autopsies and 45,000 surgical specimens, lymphoblastomas were the most common, occurring in twenty-one cases, twenty of which were in the ileum. Adenomas were next in frequency, consisting of fifteen cases, eleven of which were located in the ileum. Lipomas were the third type in frequency. In reviewing the literature Shottenfeld[2] found that more than one-half of all the lipomas of the gastrointestinal tract were located in the small intestine and almost one-third were located in the ileum. About eighty cases of ileal lipomas have been reported to date. Of the remainder of the benign types, fibromas, myomas, argentaffin or carcinoid tumors, accessory pancreatic rests and angiomas also have been reported. Eighteen per cent of Raiford's series[1] consisted of malignant tumors, in which carcinoma was located less frequently in the ileum, whereas sarcoma predominated. The lymphoblastomas usually are regarded as a borderline group.

Tumors of the small intestine may grow internally or externally. The great majority of the tumors, especially the benign, assume the internal form. Most of these are polypoid, usually adenomas and lipomas. Although any histologic type may assume the form of a polyp, the benign ones are usually small and often multiple. Sessile types are oval or round and are classified as intramural when they lie within the wall of the intestine; or they may be attached by a broad base and loosely covered by intact mucous membrane. Malignant growths predominate among the external type. They are larger, frequently single and may involve, by direct extension, the ileal lymph nodes and mesentery. They are usually infiltrative, causing a jagged, irregular thickening of the bowel wall, spreading out from the original site and destroying the normal structure of the wall. The lymphoblastomas may assume a constricting form, described by Riaford[1] as a variant of the preceding, in which there is a tendency to necrosis and excavation so that the tumor remains a hollow, irregular sphere through which the lumen passes constricted at its points of entrance and exit.

In proportion to their size polypoid, or pedunculated, tumors, offer the most complications. Lichenstein and Dutra[3] described four of the common complications: necrosis of the tumor mass, bleeding from an eroded surface, partial or complete obstruction of the lumen and intussusception. Intussusception complicates about 30 per cent of all tumors of the small intestine,[4] and lesions producing this complication are benign more often than malignant. Malignancy often causes

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a rigid infiltration of the bowel wall which tends to resist invagination. Intussusception may be caused also by intramural lesions, such as leiomyoma,[5,6] lymphosarcoma of the terminal ileum,[7] combined mural and internal lesions as angiofibroma[3] and by mural embryonic rests composed of duct-forming epithelium and smooth muscle, occurring in the wall of the ileum of an infant.[8] The intussusceptions in these cases probably were incited by peristaltic attempts of the bowel to pass the diseased segment of the wall into the subjacent segment. Intussusceptions of the ileal area may be ileo-ileal, ileocolic or a combination of both and have been described in association with volvulus of the ileum.[9] Allen, Hale and Sniffen[10] discussed an unusual case of benign tumor causing intestinal obstruction without intussusception in which a grossly lobulated, encapsulated leiomyoma of the ileum had eroded in its center to form a pit or diverticulum.

## DIAGNOSIS

A great majority of benign tumors are clinically and surgically asymptomatic and are discovered only incidentally at autopsy or exploratory laparotomy. The size, location, peristaltic activity, amount of lumenal obstruction, ulceration and degree of intussusception determine the symptoms and their time of onset. Melena and occasional fever may result from necrosis or from erosion. Complete obstruction may follow intussusception of the tumor-bearing segment of the bowel or may be due to encroachment of a large polyp on the lumen or the impaction of intestinal contents against it. No one syndrome is pathognomonic of any one histologic type. The complete intestinal obstruction may be preceded by months or years of vague abdominal complaints. The obstructive symptoms are of gradually increasing severity with intervals free from pain and other symptoms, such as nausea and vomiting. Intermittent colicky pains, usually in the right lower abdominal quadrant, repeatedly start in the same area. These attacks may end as suddenly as they begin and the patient feels well until the next attack. Constipation occurs frequently and obstipation may be present during the episodes Malaise, weight loss and alternating constipation and diarrhea may be present. This sequence of mild intestinal obstruction followed by a symptom-free period recurring at variable intervals probably results from spasm of the bowel in the vicinity of the tumor or from partial invagination. The symptom-free interval follows relaxation of the spasm or spontaneous reduction of the intussusception.

Physical signs are few, if any. Often an area of localized abdominal tenderness is noted and, in patients with large tumors or intussusceptions, a mass may be felt.

Eventually, complete intussusception may take place with concomitant symptoms and signs of acute intestinal obstruction. There is a sudden onset of severe abdominal pain, usually in the right lower abdominal quadrant, followed by nausea and vomiting. Abdominal distention occurs and bloody stools may be passed, particularly in infants. A tender, sausage-shaped mass may be felt through the abdominal wall. Marked tenderness or muscle spasm may be absent in adults because the peritoneum is protected from the strangulated segment of bowel by the sheath of the intussusceptum.[13] The commonest cause of intussusception among adults is tumor of the bowel.

Hemangiomas of the ileum,[14] which are exceedingly rare, may manifest themselves clinically by melena. Because of the rarity of this origin of melena, a thorough study of the history, physical manifestations and laboratory examinations should be undertaken in an effort to rule out other causes.

From the standpoint of roentgenologic diagnosis the ileum is the most difficult portion of the small intestine to visualize because it is hard to maintain a distending concentration of the contrast suspension

in this region and because this segment tends to seek a low level in the pelvis. Elevation from this position is not always possible.[11] Fluoroscopic methods often are more satisfactory than roentgenograms. Once the evidence of tumor is established there are no reliable x-ray evidences of benignancy. Tumors are manifested by deformity of outline of the ileum, short and sharply demarcated filling defects, by the obliteration of the mucosal pattern throughout the extent of the defect and also by x-ray signs of obstruction. In acute intussusception an x-ray may reveal a cupping defect where the intussusceptum projects into the bowel. In this condition postevacuative and air contrast films occasionally are more helpful.

Patients must be selected carefully because the time-consuming examination increases the amount of radiation received by the patient and the examiner.[12] The use of x-ray may be disappointing except when carried out during or just after a period of obstruction; in such instances, a flat plate may reveal distended loops of small intestine with the characteristic stepladder arrangement and fluid levels present in the distended loops. Barium sulfate by mouth is contraindicated in acute obstruction. When chronic obstruction is present or repeated episodes of complete obstruction occur, it should be used with caution as it can precipitate an acute obstruction. As a rule, barium enema is considered a safer method.

### DIFFERENTIAL DIAGNOSIS

The symptoms of right lower abdominal quadrant colicky pains, nausea and vomiting, which may indicate tumors of the ileum, may simulate symptoms of appendicitis, renal colic or tumor, mesenteric adenitis and other benign or malignant tumors of the ascending colon and cecum. A careful history, physical and x-ray examination may help in differentiating these conditions. When obstruction occurs, bowel strangulation from other causes, namely, volvulus or diverticulitis, should be ruled out. Pain produced by intussusception is intermittent in character and differs sufficiently in intensity from the usual colic of obstruction so that the diagnosis may be suspected clinically. The x-ray appearance of ileocolic intussusception made after a barium enema may help in differentiating.

### TREATMENT

The treatment of recognizable tumors of the ileum is surgical. Since neither malignancy nor benignancy can be diagnosed with certainty from the history, physical and x-ray findings, surgical excision, including resection of an adequate margin of healthy bowel on either side of the lesion, is the method of choice. In those cases in which the tumor appears malignant at laparotomy the corresponding ileocecal glands and part of the local mesentery should be removed along with the tumor-bearing area. In radio-sensitive lesions, such as lymphosarcomas, postoperative irradiation should be used.

In like manner, the treatment of intussusception is surgical excision. Hydrostatic methods of reducing the intussusception without laparotomy are contraindicated because of the danger of injuring the bowel and because hydrostatic methods are not able to correct the cause of the intussusception.[13] The Miller-Abbot tube may be used as a measure for decompression of the intestinal obstruction, both pre- and postoperatively. The method of choice is the resection of the segment of bowel involved after the intussusception has been reduced with an ileo-ileostomy or ileotransversostomy, depending upon the location of the tumor in relation to the cecum. It is much safer to apply manual traction to reduce the intussusception as much as possible before resection than to make an incision through the neck of the intussuscepted portion in an effort to provide more room for reduction.[13] The latter procedure may result in making an opening into the obstructed bowel or exposing the gangrenous loop with the

Fixed specimen of the resected terminal ileum, cecum and ascending colon. The cecum has been opened, the invaginated loop of ileum uncoiled and pulled upward and the intussusception exposed. The ileal lipoma, cut across, is seen protruding from the distal end (left lower corner).

subsequent danger of contamination and peritonitis. Before resection and anastomosis, a search for other tumor-bearing areas of the intestines should be made and the necessary procedures should be carried out. Care should be used in suturing the edematous bowel in the intussuscepted segment. In some cases of marked edema and inflammation, simple exteriorization followed by secondary operation may be the procedure of choice.

## PROGNOSIS

The prognosis varies with the condition of the patient, the type of lesion and the type of operation. In benign or malignant tumors the prognosis is comparable to that of similar lesions elsewhere in the gastrointestinal tract. In cases with associated intussusception the prognosis depends upon the duration and may be grave because of necrosis, gangrene, hemorrhage, obstruction and peritonitis which may develop.

## CASE REPORT

A white woman, fifty-three years of age, weighing 125 pounds, was admitted to The Hospital for Joint Diseases on March 23, 1946. The patient had malaria in 1920 and had symptoms of Graves's Disease from 1921–1929. A thyroid cyst was excised in 1923, a partial thyroidectomy was done in 1925 and thyroid cysts were removed in 1928 and 1931. The remainder of her past history was not significant.

On admission the patient complained of periumbilical, crampy pain of one week's duration; she had been feeling well prior to that time. The pain was colicky and intermittent and was associated with nausea and retching. She had been constipated, having had bowel movements about once each four days. No melena, pus or mucous was present in her stools. There was no recent change in her bowel habits. Her stools were alternately hard and soft and were described as light yellow. She usually took cathartics. A cathartic taken just prior to admission was vomited but no hematemesis was noted. Distention and eructation were present on admission but there was no flatus. No jaundice was noted. Her pain continued but it was unassociated with nausea after the first day. She had lost five pounds in the three weeks prior to admission and another five pounds one week prior.

Her physical examination revealed nothing significant except that her abdomen was soft and slightly distended and a moderately tender, movable mass was palpable in the right lower quadrant. Rectal examination was negative except for impacted feces.

The laboratory findings were not diagnostic. Urinalysis showed two plus albumen, 1.6 per cent sugar, hyaline casts, many white blood cells and occasional red blood cells. Her blood count and sedimentation rate were normal. Blood sugar was 91 mg., and alkaline phosphatase was 3.5 mg.

After a barium enema, fluoroscopic and radiographic examinations of the large intestine revealed several large globular masses projecting into the lumen of the cecum. A flat plate taken three days later revealed considerable distension of the coils of the small and large intestine.

A Miller-Abbot tube was passed four days after admission in preparation for an explora-

tory laparotomy for a cecal tumor. A transfusion of 500 cc. of whole blood was given. At operation a large, irreducible intussusception was found in the ileocecal region. Through the ascending colon a smooth, round, movable tumor was felt which was considered papillary in nature. The ileum was then transected about 3 inches proximal to the intussusception, a lateral ileotransversostomy was performed and the intervening segment of bowel, containing the lesion, was resected.

The patient's postoperative course was uneventful and she left the hospital fourteen days after the operation.

Pathologic examination of the resected specimen revealed an irreducible, ileocecal intussusception caused by a pedunculated lipoma 3 cm. in diameter and 4 cm. in length arising in the terminal ileum, which had invaginated itself and the ileal segment of its origin into the cecum. The entire intussuscepted mass was about 18 cm. in length and 4 cm. in its greatest diameter; it was edematous and indurated and its dull, reddish-blue, fibrin-coated surface indicated a marked interference with its blood supply.

## SUMMARY

1. The terminal ileum is the most common site of tumors of the small intestine.

2. Most of these tumors are benign and their clinical importance depends upon the complications of obstruction, necrosis or intussusception.

3. These tumors are diagnosed by symptoms of vague, colicky, intermittent, pain in the right lower abdominal quadrant. The pain increases in intensity with the onset of the aforementioned complications.

4. Roentgenograms and particularly fluoroscopy are useful aids in diagnosis. The suggestive radiographic signs are filling defects, deformity of bowel outline and evidence of distended bowel.

5. The treatment is surgical and consists of enterostomy and excision, reduction of an intussusception and enterostomy or resection of the tumor-bearing area of the intestine.

6. A case of irreducible, ileocolic intussusception, caused by a lipoma of the ileum and treated by resection of the affected bowel and an ileotransversostomy, is described.

We wish to express our appreciation to A. J. Beller, M.D. for his valuable help and constructive criticism in preparing this paper; and to Martin Vorhaus, M.D. for his medical cooperation in the care of the patient reported herein.

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# DIVERTICULA OF THE THIRD PORTION OF THE DUODENUM*

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A PATIENT with diverticulum of the third portion of the duodenum operated upon at the Lankenau Hospital prompted us to review the literature regarding the incidence of this condition. It was interesting to note that little mention had been made concerning the surgical approach and technic of removing diverticula of the third portion of the duodenum, owing undoubtedly to the relative rarity of the condition and to inadequately defined indications for operation. A study of the records at the Lankenau Hospital (5,219 admissions in 1945) revealed only ten patients with the x-ray-confirmed diagnosis of duodenal diverticulum since 1937; nine of these diverticula were in the second portion and in only our case was the diverticulum in the third portion of the duodenum and treated surgically.

## CASE REPORT

W. C. B., a twenty-nine year old white male, presented a history of good health until three years before admission at which time he was operated upon at another hospital for generalized abdominal pain. His appendix was removed at that time and he recovered uneventfully except for occasional "dragging" sensations in his right lower quadrant. About six months following his appendectomy the patient began to suffer from indigestion associated with occasional nausea, vomiting and some epigastric pain. The character of this pain was aching, frequently continuous for hours and quite distressing. It was localized to the mid-epigastric region and never extended below the umbilicus. However, the patient stated that his symptoms were not incapacitating until six months later when he suffered sudden hematemesis (of apparently copious quantity). He was seen by his local medical doctor and was treated on a medical regimen but he continued to have occasional minor hematemeses and tarry stools for a period of four months. At this time the hematemesis ceased. No x-rays were taken. The patient continued under the care of his local medical doctor and was able to work as a welder and carpenter but for the remaining two and a half years prior to admission to our hospital he had never been free of his continual indigestion, occasional nausea, vomiting and epigastric distress. He stated that he never ate highly seasoned or spicy foods and there was no intolerance to fats. His aching epigastric pain was most prominent about one-half hour following the ingestion of food. He obtained no relief by drinking milk but alkalies occasionally would lessen his discomfort. The patient denied drinking or smoking and maintained his usual weight of 180 pounds. His bowels moved regularly without laxatives and there was no recent history of melena. His past medical history was non-contributory as was his family history and review of other systems not mentioned here in.

Upon admission physical examination revealed a well developed, white male in his late twenties in no acute distress. His blood pressure was 130/90, temperature 98.3°F., respirations 18 and pulse 80. The only physical finding of any note was that of slight distress on deep epigastric palpation. Peristalsis was audible and there was a healed McBurney scar in the right lower quadrant. The abdomen otherwise was normal. Rectal examination revealed no abnormality.

Laboratory studies were not abnormal in regard to hemoglobin, white blood cell count, urinalysis, serum proteins and icteric index. A gastric analysis was not remarkable.

A one-day gastric x-ray study was performed and a moderate sized diverticulum arising from the superior border of the third portion of the

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duodenum was clearly visualized. (Fig. 1.) The diverticulum filled well with barium, but no evidence of any lesion within the sac could be seen. The esophagus, stomach and proximal portions of the duodenum were negative for pathologic conditions. It was the opinion of our staff that the diverticulum could certainly be the cause of the patient's symptoms and because of his comparative youth, good physical condition and not abnormal laboratory reports, surgery was decided upon.

The patient was prepared as for gastric surgery and spinal anesthesia was administered. Through a high, right paramedian, muscle-splitting incision the peritoneum was opened. Exploration of the stomach, the first and second portions of the duodenum and gallbladder revealed no pathologic condition. The large bowel and other viscera were not abnormal. A thick, heavy omentum was found attached to the old appendectomy scar. This was freed and the excess omentum was excised as it interfered with exposure of the operative site. The transverse mesocolon was divided to the right of the middle colic artery, exposing the third portion of the duodenum and the head of the pancreas. The lower border of the head of the pancreas was elevated superiorly and an attempt was made to separate it from the third portion of the duodenum. Considerable bleeding was encountered from small pancreaticoduodenal branches and these were clamped and ligated. The superior mesenteric vessels were then retracted medially and the third portion of the duodenum was more fully demonstrated and dissected free from inferior contiguous structures. This portion of the duodenum was then rolled upward, exposing, on the posterior superior surface, a diverticulum approximately 3 cm. in length and 1.5 cm. at its greatest width. This was attached to the duodenum by a somewhat narrow neck arising from the posterosuperior surface of the third portion of the duodenum near its junction with the fourth portion. Some fine fibrous adhesions binding the diverticulum closely to the duodenum were lysed. The diverticulum was clearly demonstrated and the blood vessels supplying it were divided between clamps and ligated.

The duodenum was then allowed to roll back into its normal position and the diverticulum was brought forward between the

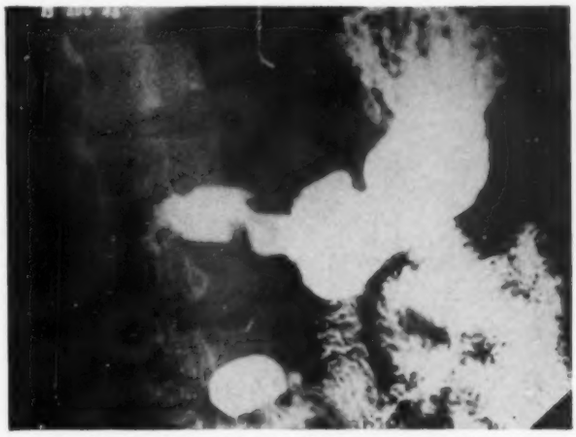

FIG. 1. Case of W. C. B. Barium meal reveals a large, well filled diverticulum of the third portion of the duodenum.

inferior border of the pancreas and the mesenteric border of the duodenum. This was accomplished by carefully rotating the third portion of the duodenum so that the anti-mesenteric border was posterior. The neck of the diverticulum was divided between Kelly clamps and turned in using a Parker-Kerr stitch transverse to the axis of the bowel. A second line of closure was made with interrupted linen sutures. The patency of the duodenum was demonstrated, there being more than a one-finger breadth lumen. All bleeding was observed to be controlled. The defect in the transverse mesocolon as well as the peritoneum were closed with continuous catgut sutures. The incision was then closed in layers without drainage and clips were placed in the skin.

The pathologist confirmed the gross diagnosis of a primary diverticulum (containing all intestinal layers) and no ulceration or other pathologic disorder was found to be present in the specimen.

The patient convalesced excellently until the twelfth postoperative day at which time his temperature suddenly rose to 102.2°F. and he suffered pain in the epigastrium associated with nausea and vomiting. On the thirteenth postoperative day his incision was reopened under general anesthesia and a periduodenal abscess was drained through the gastrocolic omentum. His convalescence from this point on was uneventful and he was discharged with no complaints whatsoever on the thirty-fourth day following the excision of the diverticulum. (Fig. 2.)

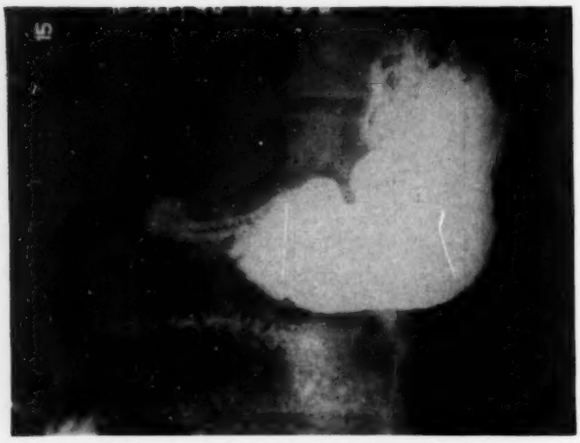

FIG. 2. Postoperative barium meal reveals absence of the diverticulum.

## SURGICAL APPROACH

We agree with Pearse's[1] statement that the excision of diverticula of the third portion of the duodenum presents no particular problem except that of adequate exposure. Indeed, we believe that adequate exposure is the main obstacle of the procedure and there are several pitfalls which may be encountered in achieving this goal.

In view of our experience with this case we are re-emphasizing the following points in procedure: (1) The most direct approach is through the transverse mesocolon, being careful to avoid the middle colic artery. (As Morton[2] says, the relatively inaccessible third portion of the duodenum can be demonstrated by approaching this part of the duodenum through the transverse mesocolon.) (2) Proper mobilization of the duodenum as stressed by Strauss[3] is essential to demonstrate adequately the diverticulum which is usually on the posterosuperior surface of the duodenum. This entails careful retraction of the superior mesenteric vessels toward the ligament of Trietz, permitting safe dissection of the duodenum from the retroperitoneal structures and exposure of its posterior surface by rolling the anti-mesenteric border forward and superiorly. The approach from the medial side of the duodenal loop is difficult and annoying as verified by Morton.[2] There are many small branches from the pancreaticoduodenal vessels which enter the duodenum about the head of the pancreas, and we found these to be troublesome when we at first attempted an anterior approach. (3) Identification of the sac, dissecting it free and amputating it at its neck may then be achieved by direct observation of the posterior duodenal surface. If the neck of the diverticulum should be found quite close to the mesenteric border, the sac may then be delivered anteriorly by rotating the anti-mesenteric border posteriorly, permitting the diverticulum to lie anterior to the pancreas. This maneuver will permit easier amputation and closure of the stump. The stump may then be oversewed with interrupted sutures and the duodenum allowed to fall back into its normal position. Maclean[4] describes a noteworthy procedure in the event that the diverticulum cannot be adequately demonstrated. He advocates opening the duodenum and searching the mucosa for the mouth of the sac. The index finger or a probe, depending on the breadth of the neck, may then be inserted transduodenally and dissection of the diverticulum carried out, using the finger or probe as a guide. (4) The question of drainage is certainly worthy of mention, and due to the postoperative complication in our case we are naturally prone to advocate a rubber tube drain to the site of operation through the gastrocolic omentum and the wound closed in layers about the drain.

## COMMENT

To attest to the relative rarity of the condition, Case[3] found diverticula of the third and fourth portions of the duodenum in only seventeen cases in a series of 6,847 consecutive barium meals. He found both sexes equally susceptible and the average age for clinical symptoms was fifty-six years.

Boyd,[5] however, states that diverticula of the duodenum are much commoner than formerly considered. He describes primary diverticula as arising usually

from the second part of the duodenum, sometimes the first part and rarely from the third part. The diverticulum may be single or multiple, sometimes producing no symptoms; but when large, Boyd concludes that the diverticulum may cause dyspepsia from pressure.

We are thoroughly in accord with L. M. Rankin's[6] statement that there is no clinical syndrome characteristic of duodenal diverticula. Rankin describes the condition as being either asymptomatic or capable of producing pain in some form. The pain may be of a dull aching type or dragging, boring sensation, referred to the right upper quadrant, midline or epigastrium. The onset of pain is usually gradual, occurring from one to four hours after meals, sometimes relief being achieved by alkalies and by food intake. Rankin believes that the symptoms may be due to inflammation or distention of the sac, from inflammation of surrounding structures or from pressure exerted by the distended sac upon adjacent tissues and organs. The symptoms may be those of some vague digestive discomfort following a gastric or duodenal, pancreatic or biliary, intestinal or colonic pattern.

F. W. Rankin and W. J. Martin[7] write that no typical chain of symptoms can be ascribed to this type of diverticulosis, and we are also in agreement that in unexplained abdominal complaints diverticulosis must be considered and ruled out.

Obviously then, the radiologist, surgeon and pathologist are all committed in making an accurate diagnosis of duodenal diverticula.

Assuming that the diagnosis has been made of duodenal diverticulum and other causes for the symptoms have been ruled out, we can further outline indications for operation by Morton's[2] classification: (A) Mechanical: (1) symptoms from local stasis, (2) symptoms from partial obstruction of the duodenum; (B) inflammatory: local diverticulitis with perforation, abscess or peritonitis; (C) neoplasm associated with diverticulum.

## SUMMARY

1. A case of diverticulum of the third portion of the duodenum is presented.

2. Surgical approach through the transverse mesocolon, adequate mobilization of the duodenum, excising the sac and advisability of drainage are discussed.

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# MASSIVE RECTAL HEMORRHAGE AS A DELAYED COMPLICATION OF APPENDECTOMY*

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MASSIVE rectal hemorrhage as a delayed complication of appendectomy is unusual. It is also uncommon for an individual three and one-half month's pregnancy to proceed to normal term and delivery following a right colectomy. We believe the case reported may explain the not too infrequent, residual, low right quadrant pain seen following appendectomies in which the pathologic conditions justified the operation.

Except in foreign literature little has been written recently regarding invagination of the appendiceal stump. Arguments both for and against have logic, but the present trend seems toward invagination. The case reported herein impresses us not as evidence against invagination of the appendiceal stump but points to the need for careful technic. The time involved and the greater incidence of infection due to additional manipulation of the contaminated stump by invagination is the strongest argument for those who do not invaginate. The time element in most cases seems insignificant, but the extra manipulation of the contaminated stump as an argument is sound.

Inversion is done for the following reason: The contaminated stump is removed from the peritoneal cavity, thereby covering the raw surface and lessening the likelihood of adhesions and subsequent intestinal obstruction. This is sufficient reason to warrant inversion, notwithstanding the contention of some that abscess formation is invited by so doing. This danger will be nullified by using small, plain catgut for stump ligature and larger chromic catgut, or non-absorbable suture, for purse-string. Abscess formation in such a procedure would cause little harm as it would empty easily into the cecum and heal promptly. We believe that invagination without ligation is too hazardous regardless of technic in placing the purse-string.

The following case report emphasizes the necessity of carefully placing the purse-string through the serosa only. Technically, the suture may include the muscularis, or all layers except the mucosa, but a "deep bite" is hazardous. We routinely invaginate the stump except when the cecum is thickened by an inflammatory process or not easily accessible for placing the purse-string.

## CASE REPORT

Mrs. R. W. L., age twenty-four, was admitted to The Methodist Hospital, July 27, 1946. She was first seen in consultation while on the Obstetrical Service, as she was about three to three and one-half months pregnant. The following history was obtained with difficulty: Her mother died at an early age of pelvic cancer and her father died of tuberculosis, also at an early age. She had malaria several times as a child and an abortion eighteen months previously, with no evidence of infection. She had an appendectomy twelve months ago in an Army Hospital in Naples, after which convalescence was smooth except for persistent soreness in the right lower quadrant which continued to the time of her admission. The patient dated the onset of her present illness four weeks before admission. Following a laxative, she had a massive rectal hemorrhage and fainted. Rectal bleeding had occurred on several occasion since but was less alarming. She was admitted to a hospital elsewhere for blood transfusions and treatment following the initial hemorrhage. The blood ranged from bright to dark red, but was not tarry. She had a low grade fever and had not

* From The University of Tennessee Department of Surgery, Memphis, Tenn.

felt well since the first hemorrhage. The patient had not realized any fever before the hemorrhage. The pain was not significant, but she still had soreness in the region of the appendectomy scar. Review of the other systems was irrelevant.

Upon physical examination the patient was very apprehensive and washed-out in appearance but not acutely ill. The examination was essentially negative except for the findings in the abdomen and pelvis. A well healed McBurney scar was present, above which there was protective rigidity and tenderness. No definite masses were felt. Pelvic examination revealed the uterus to be the size of a three and one-half months' pregnancy. Rectosigmoidoscopic examination was negative. Gastrointestinal x-ray studies, including barium enema, were reported to be negative.

Preoperative treatment consisted of several blood transfusions which corrected the anemia from a red blood count of 2,390,000 with a hemoglobin of 40 per cent to a red blood count of 4,040,000 with a hemoglobin of 76.6 per cent. Urinalysis, leukocyte and differential count, stool examination, hematocrit, platelet count, prothrombin time, bleeding and coagulation time, fragility test and total blood protein were reported within normal limits. For four days preceding surgery the patient was given large doses of sulfasuxadine, progesterone, ascorbic acid and Vitamin B complex, low residue, high caloric diet and saline colonic irrigations twice daily.

An exploratory laparotomy was advised, with the tentative diagnosis of carcinoma of the cecum. On the night before surgery 5 cc. of adrenal cortex was given intramuscularly. Under spinal anesthesia the entire abdomen was explored. The uterus was about the size of a three and one-half months' pregnancy. No pathologic disease was found except at the cecum. The tip of the cecum, from which the appendix had been removed, presented a roughened, indurated and puckered appearance. On palpation there was felt an intraluminal polypoid mass the size of an olive attached to the center of the indurated area. A right colectomy was done, followed by an end-to-side anastomosis. The incision was closed in layers using 000 interrupted silk suture. The immediate postoperative condition was good. During the course of surgery the patient received 1.000 cc. of blood.

Grossly, upon opening the cecum a polypoid mass was found as described in the surgical finding which measured 1 cm. in height and 1 cm. in diameter. At the base of the mass was a well defined triangular-shaped ulcer 1.5 cm. in length, extending through the mucosa to a depth of .3 cm. At a distance 1.5 cm. from the mass four additional discrete ulcerations were seen extending through the mucosa, each measuring approximately .6 by .4 cm. in length and width. Protruding from one of these ulcers was a piece of black suture material which on traction proved to circumscribe the polypoid mass by way of the ulcerations. A probe could be passed from this ulcer to the other three.

Microscopic examination showed ulceration of the mucosa with tunneling of the submucosa. The walls of the ulcerated tunnels were lined by inflammatory tissue of a non-specific character, composed chiefly of delicate fibroblastic tissue heavily infiltrated with lymphocytes and fibrin. The tissue was edematous and vascular. Some sections showed the suture material still to be in place in the submucosa and it was seen to be a cellular organic material, i.e., tendon.

The patient's convalescence was smooth and uneventful. The temperature remained below 99°F. For the first twenty-four hours following surgery nasal oxygen was given. No Wangensteen suction was used or indicated; 2 cc. of adrenal cortex was given every four hours for five doses and demerol, 50 mg., was given for pain. Progesterone was given in large doses during her further stay in the hospital. Intravenous fluids were given in adequate amounts during the first seventy-two hours. The diet progressed from fluids to a low residue diet on the sixth postoperative day. The patient was out of bed on the ninth postoperative day. The stools were loose and moved two to four times daily after the fifth day during a further hospital stay. The patient was discharged from the hospital well and happy, complaining of only a slight diarrhea. The patient has been seen in the office on several occasions since. The loose stools subsided gradually and by the sixth week she had returned to normal bowel habits. She delivered a full term baby normally on February 11, 1947.

## CONCLUSION

This case is not offered as evidence against invagination, but is reported to indicate the need of greater care in placing

the purse-string when inversion of the appendiceal stump is practiced. This case also suggests the possibility that an improperly placed purse-string may be the cause of vague abdominal pains following appendectomies. If a purse-string can cause such a condition as just reported, it is reasonable to assume that it can rather frequently result in similar pathologic disorders in a lesser degree. Personally, we still invaginate the appendiceal stump with few exceptions, namely, those in which the cecum is thickened and edematous and other cases in which the ceum is relatively inaccessible, making the placing of a purse-string technically difficult from a standpoint of doing so without contamination. We believe that a case of right colectomy in a three and one-half months' pregnant individual who went uneventfully to full term and normal delivery is so uncommon as to warrant reporting.

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THE sulfa drugs and antibiotics now play an important part in the treatment of peritonitis. However, they do not take the place of adequate surgery. Maintaining fluid balance is also an important factor and blood transfusions are valuable. Use of the Miller-Abbot tube in overcoming the obstruction and intestinal distention due to peritonitis is also an important factor in our recent successes in lowering the operative and postoperative mortality rates in these cases. However, good and adequate surgery is still as important as ever and must not be postponed simply because of the institution of chemotherapy and other methods. These measures supplement surgery but are not adequate substitutes for the scalpel as every competent surgeon knows. (*Richard A. Leonardo, M.D.*)

# MORTON'S TOE—A NEUROMA

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MORTON'S metatarsalgia is a definite clinical entity with more or less constant basic symptoms and only slightly variable physical findings. It was described first by Thomas G. Morton in a report of fifteen cases of plantar metatarsalgia with pain localized in the fourth metatarsophalangeal articulation. He believed that it was due to neuralgia caused by the marked posterior position of the fifth metatarsophalangeal joint. Women wearing narrow and tight-fitting shoes caused the fifth metatarsal to be pressed against the head and neck of the fourth metatarsal; and the proximity of the digital branches of the external plantar nerve, under certain circumstances, are liable to be bruised by or perched between the fourth and fifth metatarsal. His advised treatment was complete excision of the irritable metatarsophalangeal joint and the surrounding soft parts. Morton's theory has been disproved by work done independently by Betts of Australia and McElvenny of Chicago and their work was confirmed by Baker and Kuhn of Durham, North Carolina and Bickle and Dockerty of Rochester, Minnesota.

The following two cases are being presented to add to the list of patients reported in the literature as being cured by the excision of the perineurofibroma which was present on the nerve medial to the fourth toe. This nerve is made up of the most lateral branch of the nerve plantaris medialis and a small branch from the nerve plantaris lateralis.

## CASE REPORTS

CASE I. A thirty-four year old, white male was admitted to the orthopedic clinic of Station Hospital, Presque Isle, Maine, complaining of intermittent pains in the left metatarsal arch which radiated into the fourth toe and occasionally travelled posteriorly and up into the calf of the leg. The patient stated that discomfort in this foot began in 1924 and slowly increased in severity until 1938 at which time it became necessary to limit his activities and refrain from wearing high-heeled western boots. Some relief was first obtained by wearing metatarsal arch supports; however, this measure became progressively less effective.

Physical examination of this well developed, well nourished male was not remarkable except with reference to the present complaint. Examination of the left foot revealed no evidence of plantar calluses or verrucae. On manipulation the degree of mobility of the arch was normal and on weight-bearing the metatarsal arch showed no abnormalities. There was no palpable tumor present but deep pressure between the third and fourth metatarsal heads produced pain in the fourth toe. Roentgenograms of the foot were negative.

After removal of the perineural fibroma, measuring .8 by .4 cm., the patient was returned to duty one week postoperatively. Within a period of two weeks he was able to resume all forms of physical exercise and experienced no discomfort in wearing western riding boots.

CASE II. K. C., a thirty-one year old, well developed, well nourished, white female was admitted to the St. Francis Hospital on the surgical service of one of the authors, (E. W. M.). She complained of unilateral pains in the left foot about the third and fourth metatarsal heads which became severe after she walked some distance or stood for a long time. The pain would be relieved when the patient rested and removed the shoe but some residual soreness frequently remained. Surgical extirpation of the mass along with the nerve, as previously described, gave the patient immediate relief and at present she has not had any return of pain in this area.

## ETIOLOGY

The etiology of the tumor of the fourth plantar digital nerve is not definitely clear.

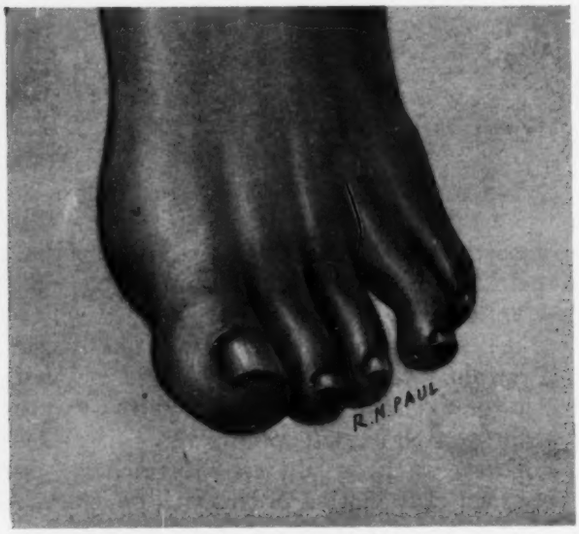


FIG. 1. Incisional approach for neuroma.

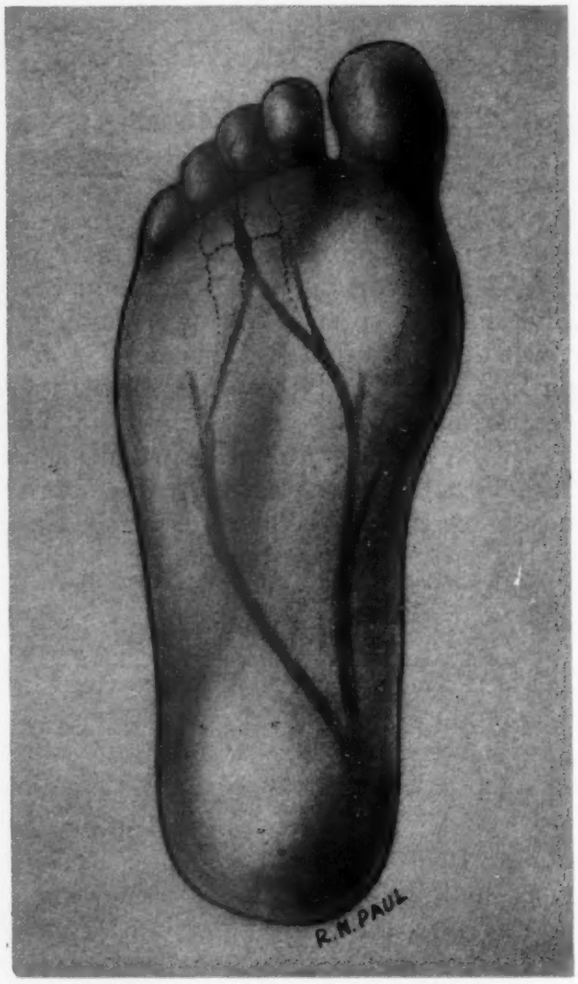


FIG. 2. Position of neuroma shown diagramatically.

It occurs in those who wear high-heeled and tight-fitting shoes but occasionally may be present in others. In Morton's classical paper he described the condition as being present in thirteen women out of fifteen patients seen and stated, "All the patients were surrounded not only by comforts but in most instances were accustomed to the luxuries of life." The frequency of sex occurrences reported by McElvenny and Kuhn were approximately of the same percentages. Although one of the two cases herein reported was a male, his condition also may be attributed to the high heel of the western shoe. The syndrome of metatarsalgia of this type definitely is due to the tumor of the plantar nerve and, as Bickle and Dockerty have stressed, this is probably caused by repeated trauma, usually due to the type of shoe worn.

## DIAGNOSIS

Morton described the pain as being localized in the fourth metatarsal phalangeal articulation. McElvenny brought out the presence of a burning sensation present in this region in the early stages and the possibility of its being accompanied by paresthesia and numbness. As the condition progresses, there is usually a periodic, sharp, lancinating pain which develops as the patient is walking; it sometimes forces the patient to stop, remove the shoe and manipulate the foot. Also, the pain may radiate to the outer three toes or even up along the nerve to the calf of the leg. An area of tenderness is frequently present if pressure is placed just posterior to the third and fourth metatarsal heads. The two patients reported herein had what appeared to be good functioning feet, good metatarsal arches and had no calluses under the heads of the metatarsals.

## TREATMENT AND PROGNOSIS

Under local or sodium pentothal anesthesia an incision 1½ inches long was made over the dorsum of the foot and extended into the web between the third and fourth toe. (Fig. 1.) This closely

resembles the incision made by McElvenny. Blunt dissection was used to expose the plantar nerve lying deep and slightly posterior to the head of the third and fourth metatarsal heads. (Fig. 2.) Complete removal of the perineural fibroma along with the nerve gives the patient complete relief. Microscopic examination of the growth revealed several nodules of fibrous tissue bound together by dense collagenous bands.

With the removal of this nerve, a small area of numbness will develop but the patient does not notice this fact unless asked about it. The prognosis is good and patients may resume all normal duties and go on wearing the type of shoe desired.

SUMMARY

Two cases of perineural fibroma are reported and the more recent literature has been reviewed. From the data of all these cases it is evident that Morton's metatarsalgia is not due to neuralgia but due to a perineural fibroma of the fourth digital nerve. It is a distinct clinical entity in itself and if the symptoms are severe, the growth should be removed surgically.

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# New Instruments

## CANCER TEACHING MODELS (PERMITTING PALPATION)*

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CANCER teaching today is inadequate. There is insufficient emphasis on early lesions. Open any cancer textbook and, for example, turn to carcinoma of the breast and you will observe photographs of ulceration, nipple retraction and peau d'orange. Similarly, photographs of "interesting" cases of carcinoma in other sites often show advanced stages of the disease. Early lesions, which are more difficult to photograph and also less spectacular, are seldom reproduced. This attention to advanced material may lead to an erroneous impression of the disease and give the physician a false and pessimistic viewpoint toward the curability of cancer.

When possible, to see and to palpate the early cancer lesion would be ideal. This method, however, is seldom used because there are not enough early cancer patients under observation; the patient and the students cannot always be brought together at the same time; and, aside from the inconvenience to the patient, there is the danger of spreading the disease by subjecting the patient to a long file of palpaters.

How could the present teaching methods be supplemented and the clinical method approximated? Moulages (models in wax) were available but were unsuited for palpation. To overcome this drawback the sculptor who had collaborated with Dickinson in the Birth Series, was consulted and the importance of palpation in the diagnosis of cancer was explained to him. It was agreed that rubber was the most desirable medium because of its varying consistency, resilience and durability. Our work on three-dimensional cancer teaching models was begun.

Previously, Dickinson and Fortuanato[1] had experimented along these lines as had Peluse[2] who reported in April, 1941 on casts made of otorhinolaryngologic specimens with translation into latex rubber. Woodland, Towson and Clark[3] in September, 1941 had similarly made casts of the spleen and heart.

Our objective has been not only to reproduce the specimen or organ in rubber but also to simulate as closely as possible the clinical conditions by reconstructing the part in its relationship to the body. This precluded direct casting from specimens.

Our technic consists of the following procedures: (1) A model of the desired part is sculptured in clay based on anatomic studies, operative procedures and clinical observation. This figure is modelled 10 to 15 per cent larger than life to allow for the usual shrinkage of rubber. (2) A plaster waste mold negative is made from the original. (3) From this the master cast, or positive, in plaster is obtained. (4) In turn a plaster piece mold negative is produced. In many of the detailed models this step is intricate as the piece mold is made up of many pieces which fit snugly into a mother mold. (5) The final translation into rubber is made by pouring natural latex, in which a flesh colored pigment is impregnated, into this piece mold, modifying the consistency of the latex so as to obtain the appropriate thickness and flexibility required for the

* From the Department of Anatomy, New York Medical School and The Cancer Prevention and Detection Clinic, Queens General Hospital, Department of Hospitals, City of New York. Aided by a grant from the Queens County Cancer Committee.

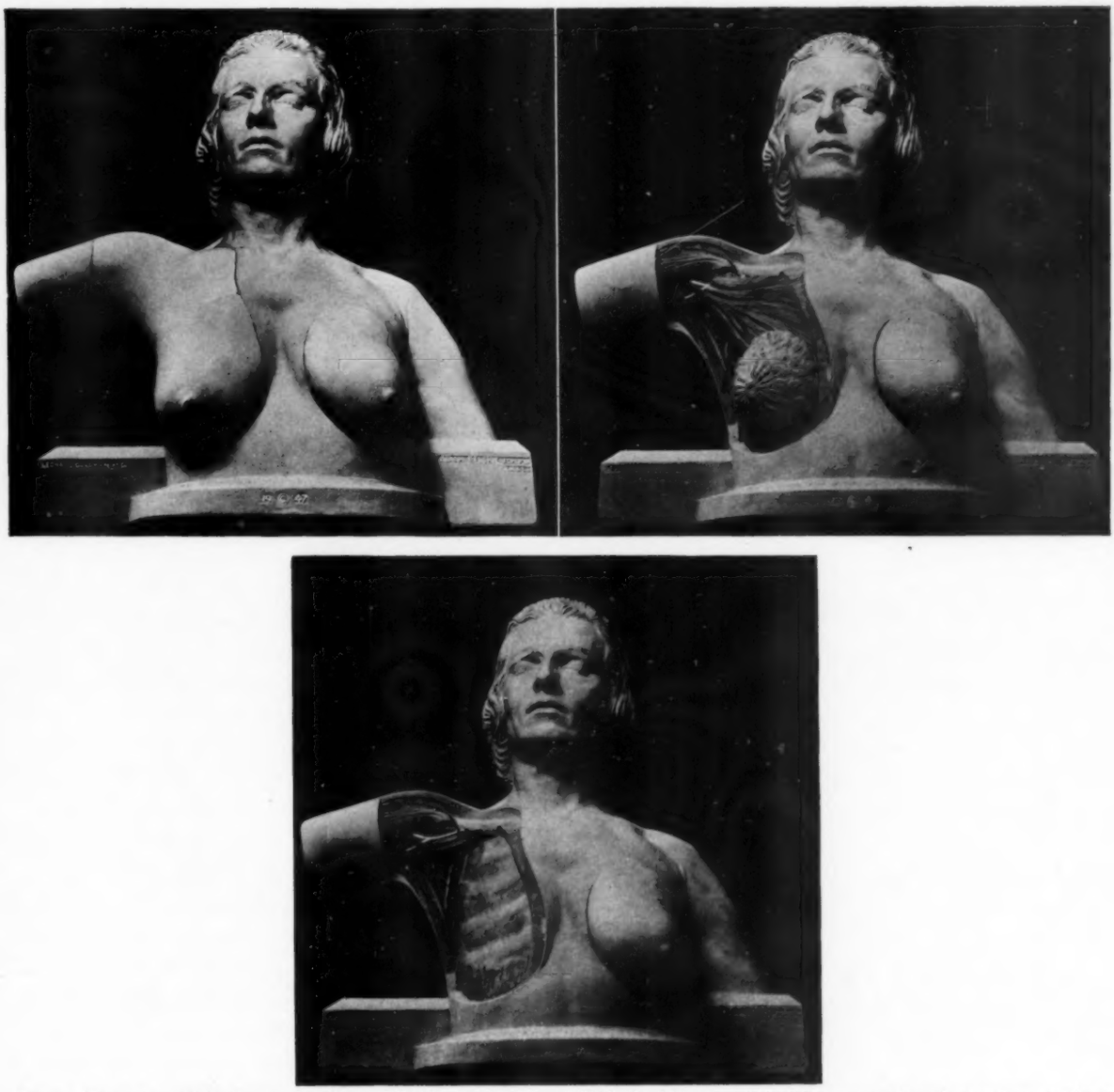
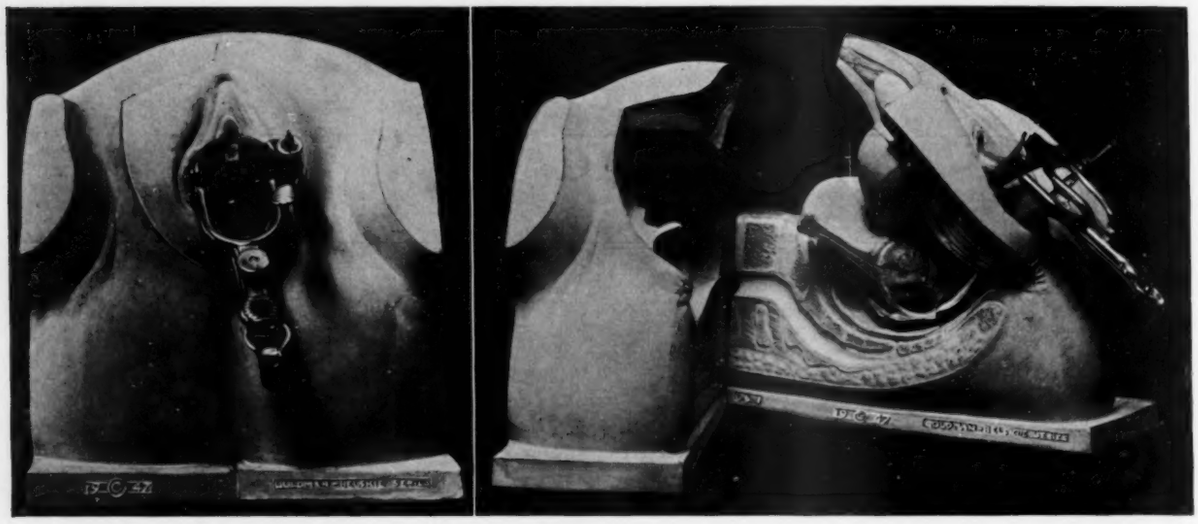


FIG. 1. Breast model demonstrating radical mastectomy. (Skin incision modified because of sculptural necessity.)

specific part. (6) The finished product which is hollow is filled with rubber flax, absorbent cotton or any material which will impart the desired differentiations in tissue consistency. (7) A more life-like appearance is obtained by retouching the finished model in color.

One model is the normal or the control. Various examples of neoplasms are superimposed upon the duplicates. For example, on the breast model (Fig. 1) a carcinoma is made palpable by imbedding plaster of paris within the breast; an adenofibroma is made palpable by inserting clay or rubber; and a cyst, by inlaying a freely movable rubber ball filled with fluid. The attachment and fixation of the carcinoma is exhibited by the use of hard rubber which, when set, simulates a desmoplastic or scirrhous reaction on the part of the tissues. Skin dimpling, so frequently found in carcinoma of the breast upon gently compressing the neoplasm, may be represented by light adherence of the tumor to the skin.

On the gynecologic model (Fig. 2A to C) other procedures may be performed in addition to digital and speculum examinations.



A B

C

FIG. 2. A, gynecologic model; B, opened model shows carcinoma of the cervix; C, cervix, anterior right half of the uterine wall and right half of the bladder wall removed. Catheter shown in the bladder.

A B

FIG. 3. A, head model; B, carcinoma of the tongue.

The cervices, being interchangeable, allow the demonstration of various types of pathologic lesions. From the abdominal side the relationship of the fundus of the uterus to the adnexa and pelvic cavity may be appreciated. One half of the anterior uterine wall may be removed as may a portion of the bladder wall (the bladder may be catheterized). In another gynecologic model it is possible to dilate the uterine canal and demonstrate the technic of dilatation and curettage preparatory to the insertion of radium.

On the head model (Fig. 3A and B) varied examinations may be practiced similar to those actually performed on a patient. A sagittal section exposes the anatomic structures and a removable half of the mandible allows study of the lingual and pharyngeal parts. Tongues are interchangeable.

In lesions not accessible to the fingers models will be constructed for endoscopic procedures, namely, bronchoscopy, gastroscopy, cystoscopy and sigmoidoscopy. Flexible armatures will be used to hold the "beings" in the position appropriate for these examinations. (Fig. 4.)

The possibilities of plastic materials are being explored as, for example, the use of a transparent plastic when vision of the underlying structures is desired.

Although these models were initiated primarily to teach early cancer, they can be utilized in other specialties. Their structural accuracy makes them suitable for anatomic study; surgical technics, obstetrical procedures and nursing methods may be demonstrated and practiced.

The teaching value of the models, like that of textbooks, lies in their availability. This requirement is met by the technic which permits ease of duplication once the original is completed.

FIG. 4. Carcinoma of the stomach.

## SUMMARY

Present cancer teaching methods fail to emphasize early lesions. A means of supplementing present teaching methods was desired.

Three dimensional rubber models, life-sized, fully colored and permitting palpation were introduced.

These models may be used in other fields.

The technic of casting permits ease of duplication.

We wish to thank Dr. Robert L. Dickinson for his unflagging enthusiasm and encouragement.

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# EFFICIENT, SMALL-SIZED, RING-HANDLED FINGER RETRACTORS

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*Rochester, Minnesota*

THE uninterrupted and adequate exposure of the operative field is an essential in the performance of good surgery in such cases as lacerating wounds involving the tendons, nerves and blood vessels. It is obvious that the longer the procedure, the less perfect the exposure becomes. This is often the result of the assistant's fingers becoming tired of holding retractors that have handles which are uncomfortable and cannot be adequately controlled. In order to enable someone to stand and hold a retractor for twenty minutes to several hours it should rest easily in the hand and require a minimal amount of pressure to control the depth and tilt of the retractor end. Traction should be obtained by means other than through pressing against a flat, smooth handle held between the thumb and fingers. It is this strain of holding and pulling on an inadequate type of handle that causes the assistant to relax or change his grip frequently and this may occur just at the time the surgeon needs the best exposure. Furthermore, structures tend to slip away from some retractors unless the instruments have properly built edges and are held exactly in the proper position. Undue movement of the tired and cramped hand with change of position also interferes with maintenance of exposure. It is of great assistance to have the hand rest on the table in a fixed position. The ends of the retractors must be of varying depths and various shaped edges so as to control the slippery tendons readily and hold nerves and blood vessels without injury to them. Thus, blunt and sharp edged retractors with enough depth and inverted tips to hold the soft tissues adequately are required.

There was a great scarcity of surgical instruments in the United States during World War II and it seemed impossible for the surgeon to get manufacturers interested in making new apparatus as they were overworked trying to supply the instruments demanded by the armed forces.

In every hospital there are discarded or broken needle holders. It was while I was looking these over that the thought occurred to me that we could make use of them and thus supply some of the needed instruments. We flattened the shank, cut off the rachet lock and altered the ends by brazing on the type of retracting ends that I thought would be most useful in a set of retractors. Several sets of these retractors were made and soon became generally used by my associates and myself in such operations as repair of lacerated tendons, nerves and blood vessels of the extremities, excision of scars, correction of Dupuytren's contracture and so forth.

We have used these instruments for some time and have found that exposure could be obtained and maintained with far greater ease and that the assistant's hands would not become cramped and exhausted even though some of the operations lasted several hours. The advantage of these retractors is that the assistant can retract the fifth finger in the ring handle while the thumb and fingers adjust the retracting end to the required depth and angle. (Fig. 1.) Once this has been accomplished, he can rest the hand against the table

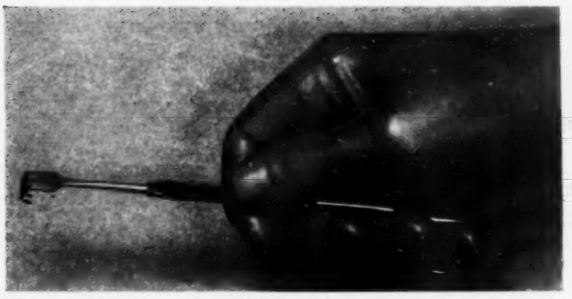

FIG. 1. Manner in which the retractors are held. Traction is obtained by the fifth finger and rotation by the thumb and fingers. The usual gripping and pulling with the thumb and fingers on a slippery, flat surface is thus avoided.

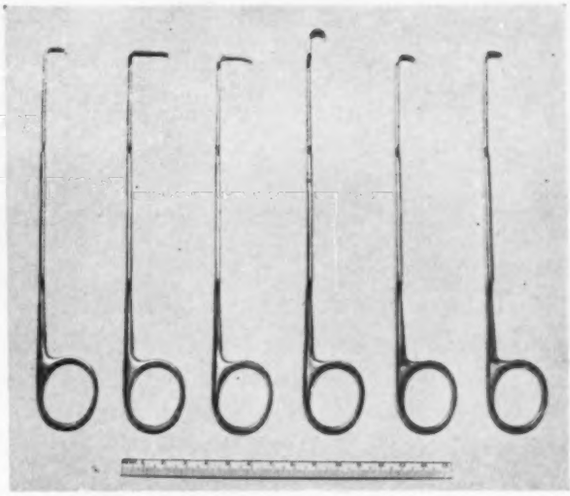

FIG. 2. Lateral view of the six retractors.

FIG. 3. The varied types of retractor ends.

and maintain the proper position without the strain of constant pulling pressure to obtain friction enough for traction and so forth on a smooth surface of the type of retractor which we used formerly. There are, therefore, two definite forces employed; the first one is that of the fifth finger pulling through the ring of the handle and the second one the rotating force through the thumb and fingers that hold the retracting edge in the desired position.

We had six retractors (Fig. 2) made 7 inches (17.8 cm.) in length, three of which had blunt edges with inverted ends. (Fig. 3.) Of these three, one was $11/16$ inch (1.7 cm.) in depth and $1/4$ inch (0.6 cm.) wide, one $3/8$ by $3/32$ inch (1.0 by 0.2 cm.) and one $1/4$ by $1/8$ inch (0.6 by 0.3 cm.). These are the instruments that we use in the region of blood vessels, nerves and other tissues which one must be careful not to pierce. Of the remaining three, two have small, sharp teeth and one has larger, curved teeth. Of the first two, the teeth of one are $5/8$ inch (1.6 cm.) in depth and $3/16$ inch (0.5 cm.) in width and of the other $1/4$ by $1/8$ inch (0.6 by 0.3 cm.). The third one has curved teeth $3/8$ inch (1.0 cm.) in width and $5/32$ inch (0.4 cm.) in depth. The sharp-toothed instruments are used on tissue which requires retraction without slipping and can withstand the sharp teeth without serious injury.

Surgeons who perform reconstructive operations on the extremities will find, I believe, that these retractors are most useful and that their assistants are grateful and more cooperative on account of the relief from cramping and exhaustion of the fingers.

# COMBINATION BIVALVE AND SELF-RETAINING VAGINAL SPECULUM

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*New York, New York*

AT one time it occured to me that in some cases in which a bivalve vaginal speculum is used a combination with that of a self-retaining or weighted speculum might be of advantage. In like manner, when a weighted speculum is used, a combination with a bivalve blade might also have indications. I, therefore, have effected such a combination. (Fig. 1.)

I have found it helpful in doing the Rubin test, cauterization of the cervix, in curettage work when the uterus is situated on a high plane or in the presence of a long vagina or when the anterior vaginal wall is so redundant that an anterior retractor has to be employed to expose the cervix. It is of particular help when working without an assistant.

I have used a hand-made model of such a combined instrument for over twenty years and believe that it is of interest and usefulness to the profession.

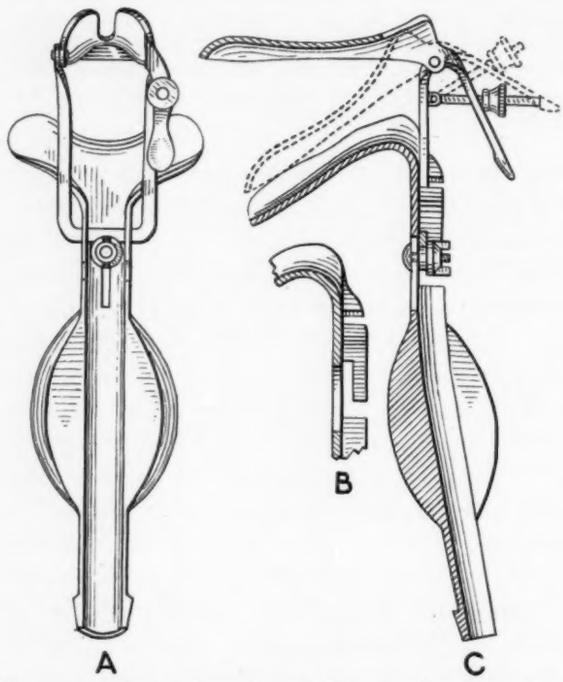


FIG. 1. A, front elevation of the speculum complete; B, vertical central sectional view of the same; C, transverse section of part of the shank throwing additional light on the removable and movable member in connection with the self-retaining part of the speculum.

# 3 SAFE, SIMPLE STEPS

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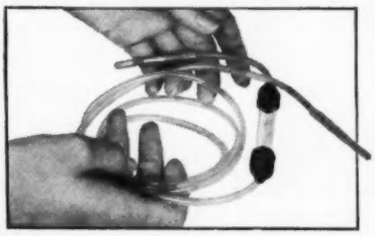

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# Outside the Ivory Tower

(*continued from page 22*)

THE first cerebral palsy center of its kind in the nation will be opened next fall at Bowling Green State University, it was recently announced by officials of the University and The Ohio Society for Crippled Children, co-sponsors of the project. At the center students in speech and hearing therapy will have an opportunity to work directly with children handicapped by cerebral palsy, a condition often accompanied by unintelligible speech, poor hearing and lack of muscular control. Children from any part of Ohio may be considered for enrollment at the center. They will have the benefit not only of speech and hearing therapy but also muscular training at the hands of skilled physical and occupational therapists working under medical direction.

A "HEALTHY and virile pharmaceutical industry in the United States is constantly reducing costs of medication to the public," Dr. Theodore G. Klumpp, president of the American Pharmaceutical Manufacturers' Association, declared. Despite "increased costs of doing business," Dr. Klumpp, who is president of Winthrop-Stearns, Inc., told pharmaceutical manufacturers of this country and Canada attending the opening session of the association's mid-year meeting, that "now is not the time to raise prices." "We have demonstrated," he said, "that this industry can stand on its own feet and produce not only our nation's requirements but the world's requirements of important drugs without governmental help or subsidy. Our industry also has reason to be proud of its record during this period of inflation. Prices of drugs have risen very little and a statistical study of this will, I am sure, show that no industry has done a better job in this respect than we."

THE National Cancer Institute grants of $810,956 for cancer control projects and for cancer teaching in medical and dental schools were announced recently by Oscar R. Ewing, Federal Security Administrator. The awards were approved by Dr. Leonard A. Scheele, Surgeon General of the Public Health Service, and had been recommended by the National Advisory Cancer Council, a group of non-government cancer experts who met in San Francisco in December to review the grant applications and advise on National Cancer Institute policies.

Eleven grants for cancer control, totalling $202,417, went to non-federal institutions and agencies to support studies of cancer diagnostic tests, occupational cancer, tumor pathology, cancer teaching methods and other special control projects. Grants to continue cancer teaching of undergraduates went to twenty-three medical schools and nine dental schools and totalled $608,538.

AS a result of the recent discoveries of medical science the human blood is performing today more life-saving jobs than sulfa, penicillin or any one of our miracle drugs declares Alton Blakeslee in the new Public Affairs Pamphlet, *Blood's Magic for All*, released by the Public Affairs Committee, Inc., N. Y.

"To meet the vast new peacetime as well as possible emergency needs for blood, the Red Cross now has under way a new program to make the miracle healing qualities of blood quickly available in all parts of the United States. "Within a few years," the pamphlet points out, "by coordination of all banks—those in the Red Cross program, private blood banks, and hospital banks—the entire country will be protected against local, regional, or national disasters. Blood supplies will not be concentrated in only a few large cities. There will be artificial arteries spanning the nation, bringing whole blood and blood medicines to the sick and the injured in any locality." At the start of the National Blood Program it was estimated that at least 3,700,000 pints of blood would be needed each year to meet civilian needs. This means one donation of blood a year by one out of every twenty-five American adults. The total needed each year will go higher as new uses are found for blood."

(*continued on page 36*)

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# Outside the Ivory Tower

(*continued from page* 34)

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Essentials of Pathology by Lawrence W. Smith, M.D., F.A.C.P. and Edwin S. Gault, M.D. F.A.C.P., with a Foreword by the late James Ewing, M.D. 3rd ed., profusely illustrated, some in color, the volume 764 pages, and containing a Bibliography, Index, Case Histories, and Numerical Index. Philadelphia; 1948. The Blakiston Company.

Detailed Atalas of the Head and Neck by Raymond C. Truex, M.S., PH.D. and Carl E. Kellner, Artist, Department of Anatomy, College of Physicians and Surgeons, Columbia University. A large book with 136 quarter or half-page illustrations in color. The illustrations are wonderful. A surgeon who does work in this field should own a copy. New York, 1948. Oxford University Press.

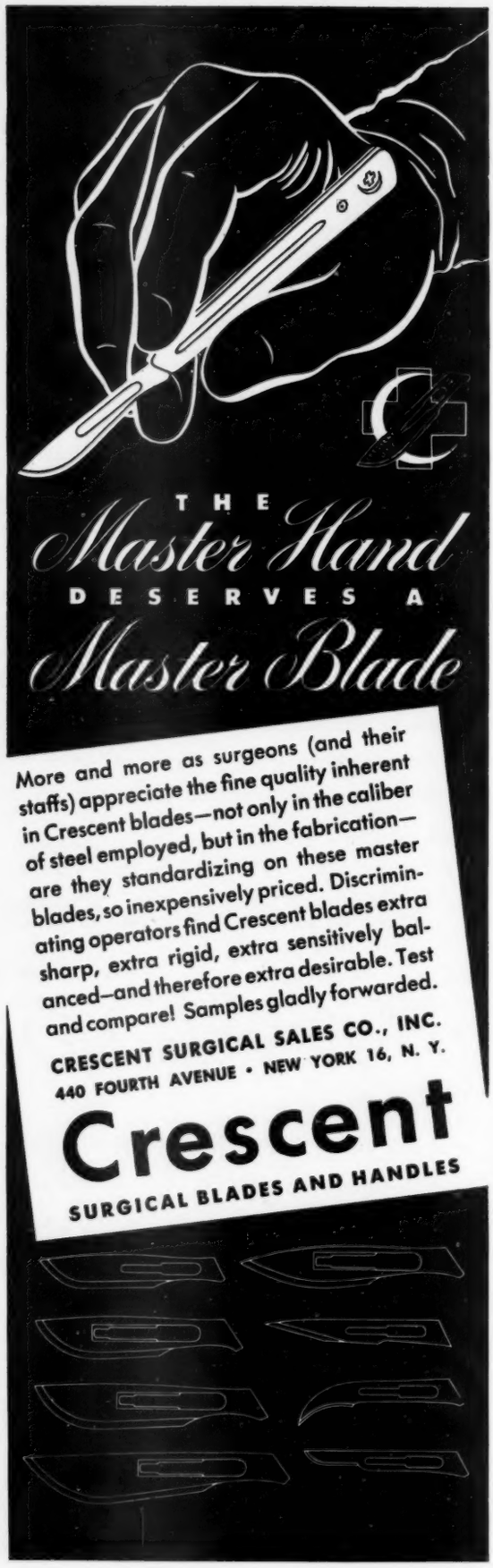
The Radiology of Bones and Joints by James F. Brailsford, M.D., PH.D., F.R.C.P., F.I.C.S. 4th ed., with 615 illustrations. Baltimore, 1944. The Williams & Wilkins Company.

Zinsser's Textbook of Bacteriology. Revised by David T. Smith, M.D., Donald S. Martin, M.D., Norman F. Conant, PH.D., Joseph W. Beard, M.D., Grant Taylor, M.D., Henry I. Kohn, M.D. and Mary A. Poston, M.A. 9th ed. At the top of its class. New York, 1948. Appleton-Century-Crofts, Inc.

Preoperative and Postoperative Care of Surgical Patients by Hugh C. Ilgenfritz, A.B., M.D., F.A.C.S., with a Foreword by Urban Maes, M.D., D.SC., F.A.C.S. Illustrated; up-to-date. St. Louis, 1948. The C. V. Mosby Company.

The Surgery of the Colon and Rectum by Sir Hugh Devine, M.S., F.R.C.S., F.R.A.C.S., F.A.C.S. and John Devine, M.S., F.R.C.S., F.R.A.C.S., F.A.C.S., with 277 illustrations, some in color. Excellent for the general surgeon. Baltimore, 1948. The Williams and Wilkins Co.

Neurosurgical Pathology by I. Mark Scheinker, M.D. Illustrated, 370 pages; indexed. Springfield, Ill., 1948. Charles C. Thomas.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1. Grollman, A.: Essentials of Endocrinology (Lippincott—Phila., 1944).
2. Carter, Cohen and Shorr: Vitamins and Hormones (Academic Press), Volume V, 1947.

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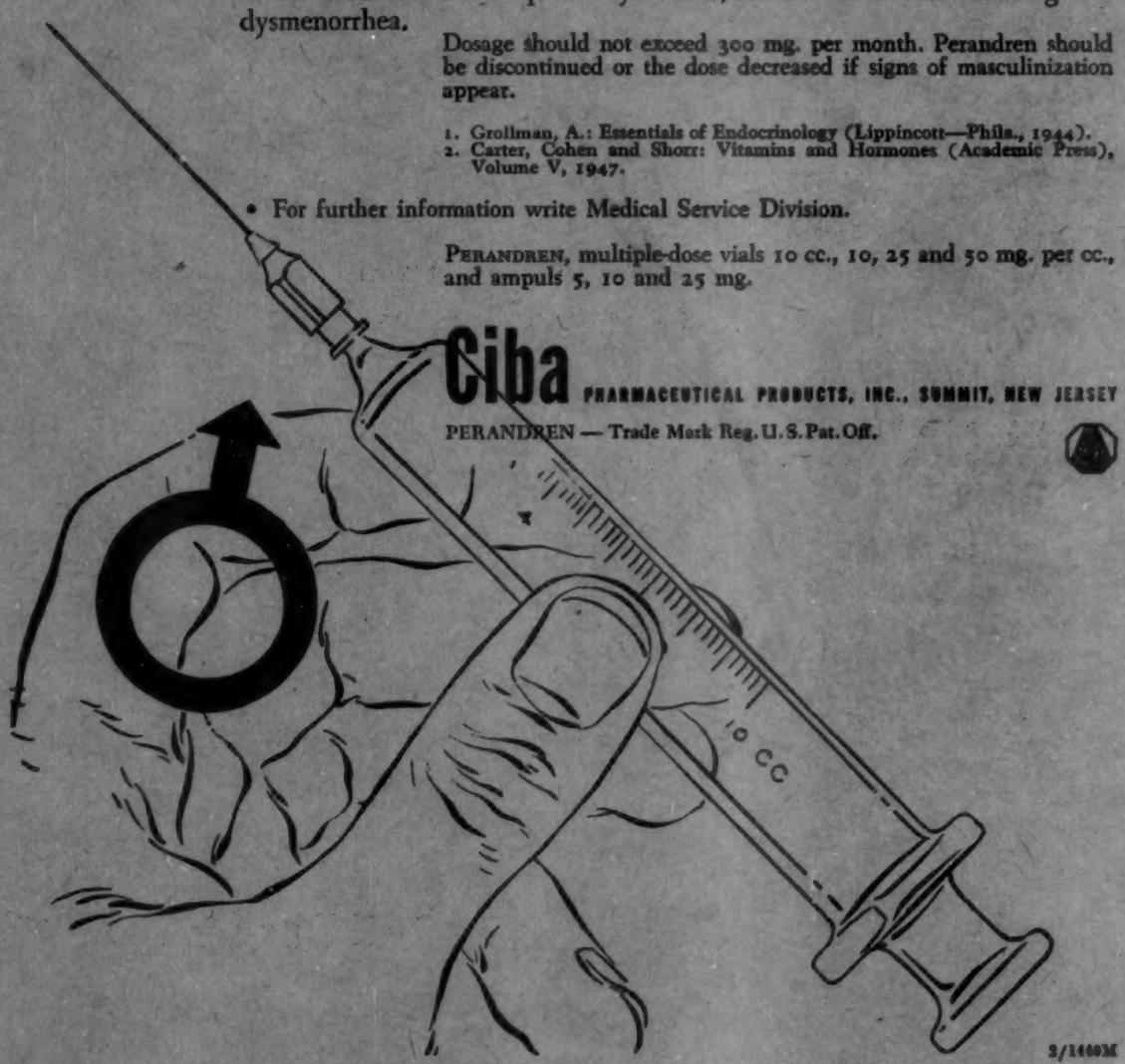


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